

US COLD WAR AIRCRAFT CARRIERS

Forrestal, Kitty Hawk and Enterprise Classes



BRAD ELWARD

ILLUSTRATED BY PAUL WRIGHT

NEW VANGUARD 211

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CONTENTS

INTRODUCTION	4
ORIGINS OF THE CARRIER AND THE SUPERCARRIER	5
• World War II Carriers	
• Post-World War II Carrier Developments	
• <i>United States</i> (CVA-58)	
THE FORRESTAL CLASS	11
FORRESTAL AS BUILT	14
• Carrier Structures	
• The Flight Deck and Hangar Bay	
• Launch and Recovery Operations	
• Stores	
• Defensive Systems	
• Electronic Systems and Radar	
• Propulsion	
THE FORRESTAL CARRIERS	20
• <i>USS Forrestal</i> (CVA-59)	
• <i>USS Saratoga</i> (CVA-60)	
• <i>USS Ranger</i> (CVA-61)	
• <i>USS Independence</i> (CVA-62)	
THE KITTY HAWK CLASS	26
• Major Differences from the Forrestal Class	
• Defensive Armament	
• Dimensions and Displacement	
• Propulsion	
• Electronics and Radars	
• <i>USS America</i> , CVA-66 – Improved Kitty Hawk	
• <i>USS John F. Kennedy</i> , CVA-67 – A Singular Class	
THE KITTY HAWK AND JOHN F. KENNEDY CARRIERS	34
• <i>USS Kitty Hawk</i> (CVA-63)	
• <i>USS Constellation</i> (CVA-64)	
• <i>USS America</i> (CVA-66)	
• <i>USS John F. Kennedy</i> (CVA-67)	
THE ENTERPRISE CLASS	40
• Propulsion	
• Stores	
• Flight Deck and Island	
• Defensive Armament	
• <i>USS Enterprise</i> (CVAN-65)	
BIBLIOGRAPHY	47
INDEX	48

US COLD WAR AIRCRAFT CARRIERS

FORRESTAL, KITTY HAWK AND ENTERPRISE CLASSES

INTRODUCTION

The Forrestal-class aircraft carriers were the world's first true supercarriers and served in the United States Navy for the majority of America's Cold War with the Soviet Union. Emerging on the scene in the early 1950s, the Forrestal-class carriers (and the subsequent Kitty Hawk class) represented a notable departure from prior carrier designs and were the first carriers capable of launching large-scale strategic jet air strikes against land-based targets, while simultaneously retaining enough organic air power to protect the carrier from incoming enemy air strikes. The Forrestal-class supercarriers introduced four powerful steam catapults, four large elevators for moving aircraft quickly between the hangar bay and flight deck, an armored angled deck for improved air operations, and the mirror optics landing aid. The larger flight deck also allowed operation of more aircraft with a wider variety of missions.

The Kitty Hawk class, a variation of the initial *Forrestal* design, featured a reconfigured flight deck that significantly enhanced air operations. Notably, the port elevator was moved aft of the angled deck runway and the starboard island was moved to the rear, with elevators one and two now forward of the island. Defensive guns were also removed and replaced by new surface-to-air missile systems. This new configuration would go on to form the basic flight deck arrangement of not only *Enterprise*, but also of the future Nimitz- and Gerald Ford-class carriers.

The Forrestal class and the improved Kitty Hawk class, together with the single-ship-class USS *John F. Kennedy* and USS *Enterprise*, the latter the world's first nuclear-powered aircraft carrier, constituted a large part of the United States Navy carrier forces throughout the Cold War, including the Cuban Missile Crisis, the Vietnam War, and the high-tension 1970s and 1980s. Collectively, these carriers made 33 deployments to Vietnam, forming the heart of the heavy carrier strike forces. Indeed, only USS *John F. Kennedy* did not serve in Vietnam.

During these times the United States operated as many as 15 large-deck attack aircraft carriers, each forming the nucleus of a powerful carrier battle group. These carriers provided a strong American presence in foreign waters, responded to countless crises, and ensured that vital sea lanes were kept open to supply Western Europe and NATO in the event of open war with the Soviet Union. Moreover, several of these great carriers continued to serve after the demise of the Soviet Union in 1991 and the end of the Cold War,



supporting air operations in Bosnia and Kosovo during the 1990s, Operations *Southern Watch* and *Desert Fox* in Iraq, and operations in Afghanistan and Iraq during the 2000s.

This work discusses the development of these Cold War titans and provides an overview of the operational impact each carrier made on the Cold War effort. As a testament to the soundness of its design, the general Forrestal-class carriers weathered 54 years – the first, USS *Forrestal* (CV-59), was commissioned in October 1955 and the last, USS *Kitty Hawk* (CV-63), an improved Forrestal design, was decommissioned in 2009. USS *Enterprise* (CVN-65), christened in 1960, was the last of these great Cold War carriers, serving proudly for 51 years until its deactivation in late 2012.

LEFT USS *Forrestal* (CVA-59) was the world's first supercarrier. The design was based on the canceled *United States* (CVA-58), but featured a flight deck island and an angled deck (NavSource).

RIGHT The *Kitty Hawk* class was an improved Forrestal design and introduced a modified flight deck as well as the first surface-to-air missile batteries (US Navy).

ORIGINS OF THE CARRIER AND THE SUPERCARRIER

Although interest in ship-based aviation surfaced in the late 1890s via Samuel Langley's proposed "Aerodrome" flying machine, naval aviation in the United States did not take hold until the early 1910s. On November 14, 1910, Curtiss Aircraft's chief test pilot Eugene Ely made the first takeoff from a ship, launching a Curtiss Pusher from a modified wooden deck affixed to the scout cruiser USS *Birmingham* (CL-2), which was anchored in Hampton Roads, Virginia. Two months later, on January 18, 1911, Ely landed his Curtiss aircraft on a 127x32ft wooden platform mounted to the deck of the armored cruiser USS *Pennsylvania* (CA-4) anchored in San Francisco Bay, marking the first use of a tailhook landing system. Despite the attention raised by Ely's efforts, the Navy turned its focus to float- and seaplanes, which dominated the fleet until the late 1910s, when developments in British carrier aviation, namely the flush deck HMS *Argus*, forced the United States to take a closer look at the concept of an aircraft carrier.

With the success of aircraft-versus-ship actions in World War I, and the obvious benefits of using aircraft for scouting and gunnery spotting, the US Navy began studying the expanded use of aviation in naval operations. As a result, in 1918 the Navy outlined requirements for an aircraft carrier



TOP The first United States Navy carrier was USS *Langley* (CV-1), a converted collier. This carrier served as an experimental carrier until the late 1930s, when it was converted into a seaplane carrier (NARA).

BOTTOM The US Navy operated seven carriers prior to World War II. One of the most prolific of these carriers was USS *Enterprise* (CV-6), which survived the war and fought in most of the significant campaigns in the Pacific (NavSource).



and, in April 1919, Congress made funds available for the conversion of a slow collier, USS *Jupiter* (AC-3), into an experimental carrier. *Jupiter* was renamed *Langley* in honor of aviation pioneer Samuel Langley and re-designated as CV-1. Conversion work began in March 1920 and the carrier was re-commissioned on March 20, 1922. On a larger front, in July 1920 the Navy announced a three-year carrier-building program that called for the construction of four dedicated aircraft carriers. This plan was reduced to three carriers a year later, but Congress refused to set aside funding.

Langley was a flush deck carrier design displacing 12,700 long tons and featuring

a 542ft (165.2m)-long flight deck measuring 65ft 5in (19.9m) abeam. The carrier featured a single catapult (later removed) and one elevator, and could operate roughly 36 aircraft. Underpowered for a carrier, the ship could only muster 15.5kt (17.8mph), meaning it could not effectively operate with the capital ships. *Langley* was an experimental aircraft carrier and operated as such until it was re-designated as a seaplane tender in 1936. *Langley* was instrumental in pilot training, experimental work, and tactical development in the mid-1920s.

Langley was joined in service by USS *Lexington* (CV-2) and *Saratoga* (CV-3) in late 1927, both of which were converted from battlecruiser hulls due to the tonnage limitations imposed by the 1922 Washington Naval Treaty. The two *Lexington*-class carriers were the largest of their day, boasting a displacement of over 36,000 long tons and carrying up to 80 aircraft on their nearly 900ft flight decks. Both carriers were fast (over 33kt/38mph) and well protected by armor. The 14,576-long-ton USS *Ranger* (CV-4) entered service in 1934, but at 769ft (234.4m) overall length was considerably smaller than its two predecessors. Despite being the first aircraft carrier built as a carrier from its conception, *Ranger* proved too small and slow for Pacific operations and was relegated to antisubmarine duty in the Atlantic during the war, where it flew strikes against North Africa and Norway.

Ranger was followed by the larger 19,800-long-ton Yorktown class, which consisted of the class namesake, CV-5, USS *Enterprise* (CV-6), and USS *Hornet* (CV-8). Yorktown-class carriers possessed three elevators and could carry as many as 90 aircraft. These carriers were heavily armed with eight single-mount Mk 12 5in/38 caliber guns, four quad 1.1in/75 caliber guns, and 24 .50 caliber machine guns. A final prewar carrier, USS *Wasp* (CV-7), joined the fleet in 1940. *Wasp* displaced roughly 14,700 long tons and had a flight deck length (741ft/225.93m) even shorter than that of *Ranger*. As the 1930s progressed, the US Navy possessed seven aircraft carriers, each with a dedicated air group of fighters, dive bombers, scouting aircraft, and torpedo bombers. *Langley* had by then been relegated to seaplane tender duties. The carriers and their attached air group had come a long way since the pre-*Langley* days of scouting and target spotting, and now possessed a considerable offensive punch against surface forces.

World War II Carriers

World War II in the Pacific opened on December 7, 1941, with a prime demonstration of what concentrated carrier-based air power could accomplish if used decisively. The six-carrier strike by Japanese naval air forces (*Kido Butai*) on the American Pacific Fleet at Pearl Harbor proved an astounding success – eight US battleships sunk, grounded, or damaged – and at once signaled the end of the battleship's reign as Queen of the Seas. Although not fully appreciated at the time by the Japanese, who for many years after Pearl Harbor continued to advocate a large, open-ocean battleship encounter in the spirit of Alfred Thayer Mahan, the Americans (whose battleships were now out of action) recognized the full potential of carrier air power and immediately made carrier operations the centerpiece of their campaign to retake the Pacific. Key to this carrier force was the Essex-class carrier, of which 36 were ordered and 24 were built. First commissioned in December 1942, the Essex-class carriers displaced 27,100 long tons and had flight decks measuring 862ft (262.7m) for the short hull version or 844ft (257.3m) for the long hull version. Unconstrained by the naval treaty limitations, each carrier could operate between 90 and 100 aircraft and reflected years of prewar aviation experience.

By war's end, the United States' immense carrier fleet had turned the tide against the Japanese, sinking all six of the Imperial Japanese Navy carriers involved in the 1941 Pearl Harbor attack and destroying the remainder of the Japanese carrier fleet. Moreover, American carriers had provided vital close air support for amphibious operations during Admiral Chester Nimitz's island-hopping campaign in the Central Pacific and the efforts to retake the Philippines.

Post-World War II Carrier Developments

Following the war, the once-formidable United States Navy carrier force was immediately slashed from over 99 aircraft carriers, including 17 of the Essex-class fleet carriers, to fewer than 20 carriers by 1948, including the three new 45,000-long-ton Midway-class carriers – USS *Midway* (CVB 41), USS *Franklin D. Roosevelt* (CVB 42), and USS *Coral Sea* (CVB 43). Possessing a flight deck of 972ft (296m), each carrier could operate up to 130 aircraft of the era. *Midway* was commissioned in late 1945 and its sisters followed in October 1945 (*Franklin D. Roosevelt*) and October 1947 (*Coral Sea*). The three additional Midway-class carriers under contract (CVB 44, 56, and 57) were canceled.

While the Navy struggled to determine its proper post-war carrier force structure, other factors were being introduced that would significantly impact not only carrier procurement, but also carrier design. Budgetary constraints were limiting the overall size of the US military, forcing the services – especially the Navy and the newly formed Air Force – to compete for funding. Jet aircraft were now joining the fleet in large numbers and were proving difficult to operate on the smaller Essex-class carriers without major modifications to the ships. Due to their slow engine spool time, jet aircraft needed a longer takeoff distance or at least assistance from catapults; likewise, the faster approach speed also meant that the jet aircraft needed more room to land and heavier arresting gear. Jet aircraft also burned more fuel, which necessitated more storage on the carrier for jet fuel. Moreover, there was concern over the added weight of the new aircraft and the wear and tear on the wooden flight decks. For these reasons, Essex-class carriers were too small. Lastly, nuclear



The Navy sought a supercarrier design as early as 1946 in order to operate the heavier jet bombers that were envisioned to carry atomic weapons.

United States (CVA-58) was designed as a flush deck carrier with four catapults (NavSource).

weapons meant that the Navy needed larger bombers to haul atomic weapons over long distances for strikes against enemy mainland targets. These bombers would, by design, be much heavier than aircraft of the day.

A partial solution to the problem was an aggressive Essex-class carrier modernization program, referred to as Project

27A. This effort involved strengthening the flight deck to accommodate aircraft up to 40,000lb, installing hydraulic catapults, removing the twin 5in/38 caliber gun mounts to provide more deck space, increasing elevator strength, increasing aviation fuel, and installing jet blast deflectors behind the catapults. Project 27A modifications began on USS *Oriskany* (CV-34), an Essex-class carrier still under construction at the end of the war, and conversion was completed in September 1950. *Oriskany* was the first of nine such Project 27A Essex modifications. Plans were also being evaluated to modify the larger Midway-class carriers, and others studied the concept of a Midway follow-on.

The operation of jet bombers presented an even more significant problem for the carriers than those surrounding jet fighters. At the time, the Navy was pursuing several heavy jet bomber designs in the 100,000lb range, which were too large for even the Midway-class carriers. It was envisioned that these new bombers would carry atomic weapons, thereby providing the Navy with a strategic asset to complement its already-proven tactical mission. Given these constraints, the obvious solution was a new class of aircraft carrier. Despite the impending budgetary woes, work began in early 1946 on a new carrier design (initially termed the CVB-X) that would specifically be able to operate the heavy jet bombers, which were anticipated to enter service in the late 1940s and early 1950s. The end product of these efforts was the Navy Ship Characteristic Board (SCB) design 6A, later named *United States* (CVA-58).

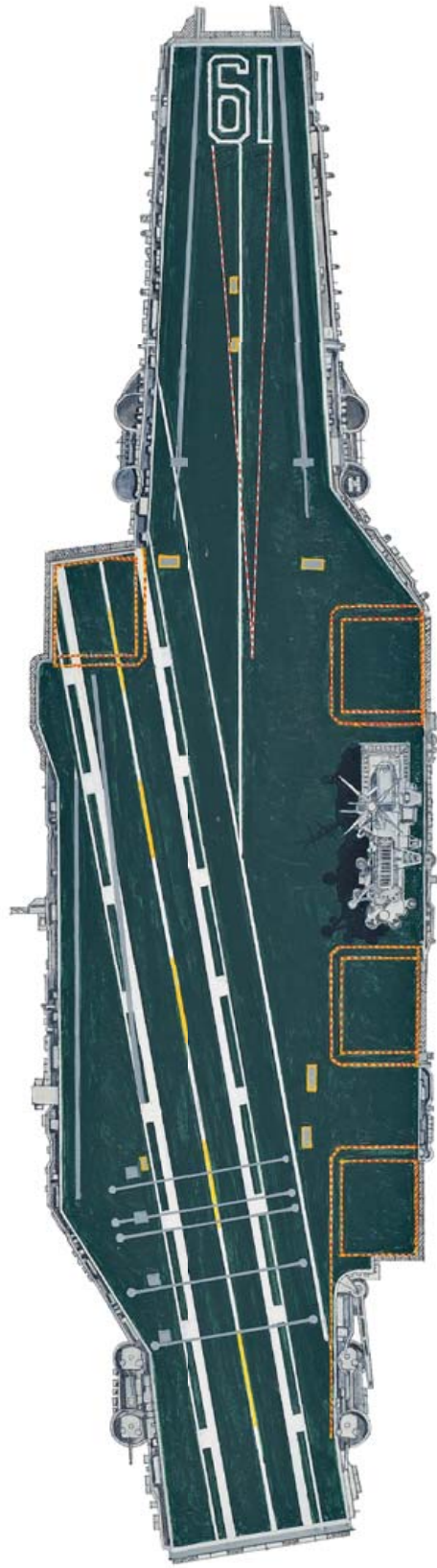
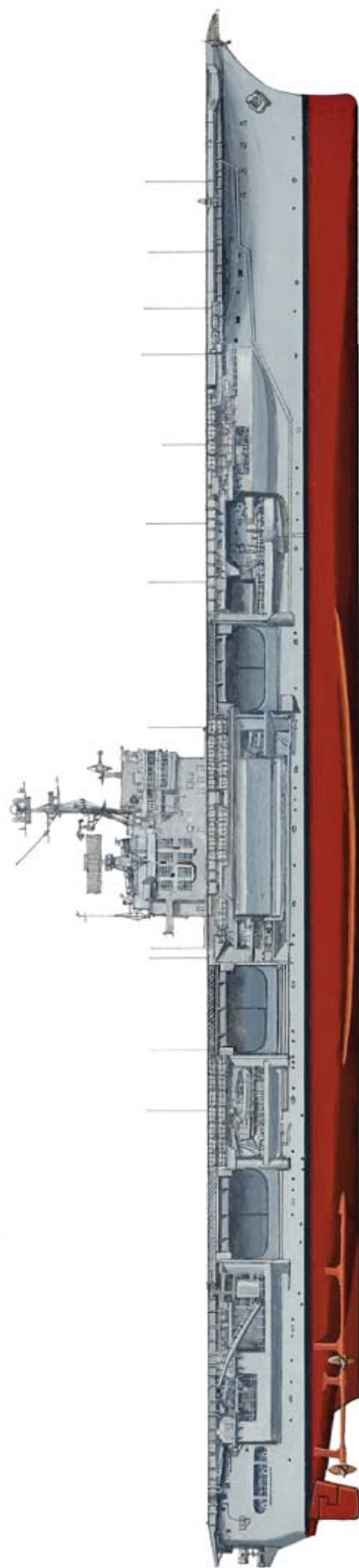
***United States* (CVA-58)**

USS *United States* represented a quantum leap forward in capability and was the first aircraft carrier designed from its outset to operate jet-powered aircraft. With an overall length of 1,090ft (332.2m) and a molded beam of 130ft (39.6m), *United States* would weigh over 65,000t, making it the largest warship of its time. The carrier was to feature four catapults – two on the bow and one on each side of the flight deck – capable of operating the new heavy jet bombers. The carrier featured a flush deck to provide as much operational space as possible for the aircraft. The island structure would be raised and lowered using an elevator, allowing it to be lowered flush with the flight deck during air operations, thus providing an obstruction-free deck. Four deck-edge elevators were available for moving aircraft between the hangar and flight

A

USS *RANGER*

Ranger was one of the most celebrated of the Forrestal carriers and was featured or at least seen in a number of movies including *Top Gun*, *Star Trek IV*, and *The Final Countdown*. *Ranger* was the only Forrestal-class carrier to retain its original gun sponsons, although the five-inch mounts were removed and replaced by surface-to-air missiles. The carrier made several Vietnam deployments and participated in Operation *Desert Storm*.



deck. The total carrier air group was estimated at 12–18 heavy bombers, each with a 2,000-mile range, and approximately 54 jet fighters (some sources report as many as 80). Defensive armament included eight single-mount Mk 12 5in/38 caliber guns, 16 76mm/70 caliber guns in twin mounts, and 20 Oerlikon 20mm cannons. Power was to be provided by eight 1,200psi (8.3MPa) Foster-Wheeler boilers and four Westinghouse steam turbines, generating 280,000shp (209MW) for a top speed of over 33kt. As a reflection of its immense size and capabilities, *United States* was aptly referred to as a “supercarrier.”

As the Navy pressed forward with its carrier design, a long-standing feud intensified between the Navy and the Air Force as to each service’s respective mission. The Air Force, which at the time was focussing on strategic atomic bombing, had proposed a large fleet of heavy bombers (70 air groups) based on the Convair B-36 Peacemaker, which had entered service in August 1946. Concerned the Navy’s supercarriers and their carrier-based long-ranged bombers would encroach on their strategic bombing mission, the Air Force vehemently opposed the construction of *United States* and the Navy’s jet bombers. The Navy, while on one hand wanting an organic atomic capability, nevertheless saw the nuclear mission as a supplement to, rather than a replacement for, the Air Force’s strategic bombing role. With its success in World War II, the Navy wanted a carrier design that could enhance the tactical strike capabilities developed during the war and provide for sea control and the support of amphibious operations.

Given the limited funding available after the war and the massive peacetime demobilization under way, the US military could not afford to pursue a carrier fleet based around the \$189 million supercarriers while at the same time purchasing the proposed 100 B-36 strategic bombers sought by the Air Force. According to the Navy, based on its experiences in the Pacific Theater during World War II, Air Force bombers would be of limited value against Soviet air defenses, and flexible supercarrier battle groups offered the most cost-efficient means of striking Soviet targets.

The Navy obtained approval for the first of four new supercarriers on July 29, 1948, when President Harry S. Truman signed the Naval Appropriations Act of 1949. The supercarriers were to operate in four carrier task forces, each centered on a United States-class supercarrier, with a Midway-class carrier in three of the task forces and two Essex-class carriers in the remaining task force. The bulk of the antisubmarine and fighter protection would be provided by the smaller carriers. As of 1948, Navy plans called for each of these supercarriers to be constructed in successive years (Fiscal Year [FY] 49 to FY52), with all operational by 1955.

Construction of the keel began on April 18, 1949, at Newport News Shipyard in Virginia. However, Truman’s Secretary of Defense, Louis Johnson, who sided with the Air Force and Army’s strategic viewpoint, abruptly canceled *United States* just five days later on April 23, without consulting the Secretary of the Navy or the Chief of Naval Operations. Johnson felt the supercarrier and its aircraft would be redundant for the Air Force’s strategic bombing mission. Johnson also reduced the carrier fleet from eight to four Essex-class carriers, three Midway-class carriers, and air groups reduced from 14 to six. As a consolation for these reductions and cuts, the Navy was authorized to pursue improvements to the Midway class, to modernize the wartime Essex carriers, and to deploy the AJ-1 Savage and the 70,000lb jet-powered heavy bomber, which became the A-3 Skywarrior.

Even though *United States* was never built, it nevertheless played a vital role in shaping the design of future carriers. Indeed, it served as the starting point for construction of what would become one of the most significant aircraft carrier designs, the Forrestal class. Despite cancelation of *United States*, Navy planners continued working on the design and exploring potential improvements, including those of the steam-powered catapult and angled flight deck, which were being evaluated by the Royal Navy.

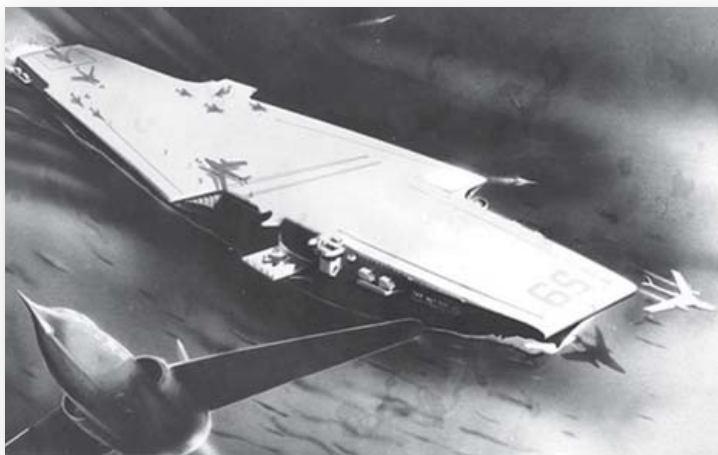
Despite the obvious deficiencies in carriers of the day, a strong interest in expanding carrier force did not surface until the outbreak of the Korean War in June 1950. When hostilities began, American, British, and Australian carriers were the only air forces capable of providing tactical resistance to the North Korean onslaught. By the war's end the carrier had again established itself as an effective means to project air power, in particular tactical air power against land-based targets. In all, 12 American carriers participated in the Korean War, operating a mix of propeller (AD-1 through AD-4 Skyraiders and F4U Corsair) and jet (F9F Panther and F2H Banshee) aircraft. Task Force 77's carriers operating from the Sea of Japan flew over 255,000 sorties.

With the lessons of the Korean War and the shortfalls of the then-carrier-fleet composition fresh at hand, the Navy once again pushed for development of a new class of carriers. What resulted was a scaled-down version of the canceled *United States*. Named in honor of the first US Secretary of Defense and former World War I naval aviator James Vincent Forrestal, the new carrier displaced 59,000t and measured 1,039ft (316.6m) long by 129.5ft (39.4m) abeam. The flight deck incorporated several key British innovations, including the armored, angled flight deck, steam catapults, and the mirror lens landing system. *Forrestal* represented a multigenerational leap forward in aircraft carrier design over any carrier of the day and was so successful that it formed the basis for all subsequent US Navy carrier designs.

THE FORRESTAL CLASS

Even with the cancelation of *United States*, many in the Navy continued to push for a new carrier design. In August 1949, for example, OP-55, the studies arm of the Deputy CNO (Air), proposed a flush deck variant of the Midway class or, at a minimum, conversion of some of the Essex-class carriers to a flush deck configuration. Here, the belief was that long-range bomber aircraft could not successfully be launched from a carrier with a fixed island structure. Hopes were raised in 1950 as Representative Carl Vinson (D-Ga), Congress' most outspoken advocate of the Navy, let it be known that Congress would likely back a new carrier, albeit one considerably smaller than *United States*. Vinson suggested a 60,000t outer limit be placed on any design.

As this early artist's sketch shows, *Forrestal* was based heavily on *United States*' design (NavSource).



Vinson's suggestion was met with receptive ears. Since the cancellation of *United States*, studies had been underway at the Bureau of Ships (BuShips) to determine what trade-offs could be made to reduce the overall size of a new carrier. These studies used *United States* as a starting point and incorporated other concepts from previously discarded designs. Moreover, these studies reflected the shift in mission thinking since 1946, which had seen the Navy move from strategic strikes by a small number of large bomber aircraft, as portended by *United States*, to more traditional tactical air strikes mounted by a large number of smaller aircraft, which was akin to carrier usage in the Pacific. This shift was also facilitated by the successful miniaturization of atomic weapons, which made possible delivery by fighter-sized aircraft.

As mentioned before, the real motivating factor behind the development and acquisition of *Forrestal* was the outbreak of the Korean War on June 22, 1950. At the time, the sole US Navy Pacific Fleet carrier able to respond was Essex-class carrier USS *Valley Forge* (CV-45). Strikes from the carrier began in earnest on July 3, and helped slow the North Korean advance by providing air cover to retreating ground forces. On July 11, the Joint Chiefs of Staff recommended postponing any further discussion of reductions in carrier force levels and, the following day, SecDef Johnson agreed to authorize a new carrier construction.

By October 28, 1950, a revised FY50 construction program was rendered, which included a new carrier (SCB-80), along with various SCB-27 conversions and modifications to the Midways. The request was approved by Navy Secretary Francis P. Matthews two days later and the Navy was officially on track for construction of the first new carrier class since the Midways of the mid-1940s. Commencing with FY52, a new carrier was to be constructed each year. Indeed, authorization was given for six large carriers running through FY57. Although force levels were not set at that time, in part due to the need to replace so many carriers from the World War II era, the Navy would by August 1953 settle on a force level of 15 attack carriers, of which the new *Forrestal* class would be the centerpiece.

Given the SecNav's approval and willingness of both Congress and SecDef Johnson to support carrier construction, BuShips immediately began modifying its carrier plans, which it had been touting since mid-summer. The plans called for an all-weather carrier with an enclosed bow and a flush deck design similar to *United States*. A number of studies were conducted and completed by early 1951, and a contract was signed on July 12 for construction by Newport News Shipbuilding. Congress authorized the contract on July 30 and released a joint resolution stating that the carrier, now designated as CVA-59, would be named *Forrestal*.

Forrestal's design went through a number of modifications during its development phase, with consideration given to removal of one of the four elevators, reducing armaments, reducing armor protection, and proper aviation fuel and ordnance requirements. In the end, the four deck-edge elevator configuration was adopted, providing a dedicated elevator for each catapult. Moreover, the hangar bay was set at 25ft (7.62m) – a height sufficient to allow stowage of the new jets in production, such as the A3D, which required 22ft (6.7m) of headroom. As designed, the carrier featured four hydraulic H9 catapults, a retractable island bridge structure, and side-mounted smoke stacks.

The catapults were quickly replaced with a slotted-tube design actuated by an explosive powder charge. These new catapults, designated as C7 and the lighter C10, provided tremendous savings in space and weight. By 1953, while the carrier was well under construction, the powder-driven catapult system was replaced by a new version of the heavy C7 and a new C11, which was based on the British BXS-1 steam catapult system tested aboard HMS *Perseus* in August 1950. This system was later tested by the USA between December 1951 and February 1952.

The retractable island was itself the subject of some debate, with many aviators calling for a return to the flush deck designs of *Langley*, original *Ranger*, and *United States*. When construction began, a retractable island was to be located at the forward starboard side of the flight deck, just ahead of the starboard catapult. Even so, a contingency was incorporated that permitted installation of a permanent island structure between the aft starboard catapult and starboard elevator, if operations deemed it necessary.

To reduce possible smoke on the flight deck during air operations, exhaust from the engines was vented using a crossover system to stacks on each side of the carrier that could be folded down horizontally during air operations. The original plans specified four stacks on each side, which were expensive and space-consuming.

As the design moved forward, the hull was redesigned, giving the ship a conventional underbody and transom stern in place of the twin skegs configuration inherent in the *United States* design. This modification increased the waterline length from 980 to 990ft, but improved survivability, since the inner and outer drive shafts would be further separated, making the propulsion more resistant to torpedo damage. A third rudder was also added to improve survivability.

Perhaps the most significant modification to the original design came in October 1953, when authorization was given to incorporate the angled deck arrangement. As designed, *Forrestal* was a conventional or axial deck carrier, which meant that aircraft landing traveled down the carrier's centerline and were stopped by either the arresting wires (hopefully) or the safety barricade. If the barricade failed, the landing aircraft would crash into the parked aircraft, which had been relocated to the carrier's bow for recovery operations. The angled deck enabled the carrier to conduct both launch and recovery operations and to prevent landing accidents associated with a barricade miss. With the angled deck configuration, the landing zone of the carrier was canted to port and away from the island structure and bow of the ship. If an aircraft missed a wire during recovery, the aircraft could simply apply power (bolter) and take off for a second attempt.

The British had been working on the angled deck concept since August 1951. Early tests were performed on HMS *Triumph*, a light carrier that had a 10-degree angled landing area painted on for touch-and-go



Two A-5 Vigilantes of CVW-7 sit near the aft starboard elevator aboard *Independence*. The A-5 was one of the jet bombers that set the tonnage parameters for the design of *Forrestal* (US Navy).



Tests were conducted on *Forrestal* to see whether the carrier could operate the C-130 as a Carrier On-Board Delivery (COD) aircraft. The tests were successful but deemed too risky for routine carrier operations (US Navy).

landings. The US Navy performed similar tests aboard USS *Midway* and in 1952 modified USS *Antietam* (CV-36) with a port sponson and angled deck. The results were spectacular and plans were made to incorporate the design into the FY55 carrier, which would become USS *Independence* (CV-62). Angled decks were also authorized for a select number of modified Essex-class carriers (SCB-27C) and the Midways (SCB-110).

Even though *Forrestal*, and by now *Saratoga*, were already under construction, the CNO authorized the entire Forrestal class to be fitted with the new angled deck, as well as a conventional island structure. This, of course, necessitated a redesign of the flight deck layout and meant moving the aft port elevators to starboard. The island was then located amidship with one elevator forward and two aft of the island. The redesign also meant relocating the starboard fighter catapult (C11) to port on the sponson (now cantilever), which prevented simultaneous launch from the waist catapults. This redesign made USS *Ranger* (CVA-61) the first US Navy carrier built from the start as an angled deck carrier.

Other modifications to the original *Forrestal* design saw a reduction from four to three hangar bays, each with elevator service from the starboard side. The new angled deck, while providing all of the advantages previously noted, also meant that fewer cross-deck pendants (or wires) were required for landing aircraft, which in turn meant fewer arresting gear engines and more free internal space. The carrier deck reconfiguration also provided benefits in electronics and engine/exhaust, yielding even more space. Placing the radar and communications antennas on the higher island structure not only provided greater functionality for the equipment, but also eliminated redundant radars and the associated wiring. Moreover, the removal of the original uptakes (exhausts) and use of an island stack saved much-needed space.

As many as ten Forrestal-class carriers were planned; however, funding was only made available for the first six, FY52 through FY57, and the Navy's request for another in the FY60 Program was rejected. FY58 represented USS *Enterprise* and no carrier was authorized for FY59.

FORRESTAL AS BUILT

Carrier Structures

The Forrestal-class carriers represented the largest warships to date. Displacing 59,650 long tons empty and nearly 79,000t with a full load, the carrier was smaller than *United States* but nonetheless much larger than *Midway*. Overall size measured was 990ft (301.7m) long and 129.6ft (39.5m) abeam at the waterline; the draft was 36ft (10.9m). The carrier's displacement grew over the years and ultimately reached 83,000t by its retirement, resulting in an additional foot of draft. From top to bottom, *Forrestal* stood at nearly 25 stories.

Forrestal featured a fixed island superstructure with two bridges, one above the other, at the forward end of the superstructure. The top level served as the navigation bridge and the lower served as the flag bridge. A navigation bridge extended further aft and featured a small auxiliary conning station on its starboard side. The windows on both bridges were

canted, allowing a better field of view onto the carrier's deck.

Carrier air operations were monitored from Primary Flight Control (Pri-Fly) located at the aft end of the island. Pri-Fly was L-shaped, running along the port and stern of the island. Pri-Fly controlled air operations around the carrier, from entry into the pattern until hand-off to the Landing Signal Officer (LSO), who actually brought the aircraft aboard. A small enclosed housing contained a television monitoring system used to record carrier landings. The Pilot Landing Aid Televisions, also called PLAT, could be viewed from the squadron ready rooms.

The carrier had a crew of roughly 4,500, including 2,750 officers and enlisted, and an air group of 2,150. Of the aircrew, these were divided into squadrons and included officers, enlisted personnel, and further air group staff. Commanding the carrier was a captain; the air group (later air wing) was commanded by a commander and later a captain, who served as Commander, Air Group, or CAG. Carrier air operations around the ship were overseen by the Air Boss, who usually held the rank of commander.

The Flight Deck and Hangar Bay

Forrestal's flight deck, measuring 1,039x252ft (316.6x76.8m), covered nearly 174,240sq ft (approximately 4 acres) and provided considerably more room to maneuver the larger jet aircraft being introduced to the fleet. The flight deck was armored with 3in-thickness protection. The four elevators were positioned with three on the starboard side (numbers one, three, and four from bow to stern) and a single elevator (number two) on the port side at the forward end of the angle deck. The elevators were edged by a retractable fence that could be lowered when the elevator was up. A series of cables aided and supported the elevator during movement. All of the elevators measured 63x52ft (19.2x15.8m) in size. One drawback of *Forrestal's* flight deck design was the positioning of elevator two on the port side. Because the elevator was located at the end of the landing portion of the angled deck (and at the end run of catapults three and four), it was almost always in the raised position, which meant that it was not usable unless the only air operations were launches from bow catapults one and two.

Just below the flight deck and the 03 level – which housed spaces including ready rooms, catapult and arresting gear, berthing, intelligence and combat information centers – was the hangar deck, which consisted of three nearly equal bays encompassing some 75,000sq ft (roughly 2 acres). The forward end of the hangar began at the opening for elevator number two. The bay accommodated between roughly 28 and 40 aircraft depending upon their size. Each bay was separated by a large fire-proof and blast-proof door, and elevator openings were sealed with heavy retractable doors. The hangar bay was used for aircraft storage, but more so for aircraft repairs, including removing engines



The island superstructure design of the *Forrestal*-class carriers featured two forward bridges, the lower was a flag bridge and the upper bridge was for navigation. The Primary Flight (Pri-Fly) control was located aft of the section of the island facing the flight deck landing area. Note the lower half of the island is painted black to help hide exhaust gas discoloration. The dome-shaped structure was a satellite communications antenna (US Navy).

This aerial view of *Forrestal's* deck during sea trial shows the location of the island and elevators – one forward and two aft on the starboard side, and one at the end of the angled deck area (US Navy).



Carrier Air Wing

The offensive punch of an aircraft carrier is its Carrier Air Wing or CVW. Known as a Carrier Air Group until 1962, the CVW is an operational unit composed of several squadrons and detachments of fixed wing aircraft and helicopters. Each squadron within the air wing has a distinct mission or set of missions based on the aircraft type. Typically, the air wing consisted of at least two fighter squadrons (VF), two or three bombing or attack squadrons (VA), and several smaller squadrons or detachments of special-mission aircraft. For example, in the mid-1950s, when *Forrestal* first deployed, its air wing contained the following: two fighter squadrons, VF-14 (F3H-2 Demons) and VF-84 (FJ-3 Fury); two light attack squadrons, VA-15 (AD-1 Skyraider) and VA-76 (A-4 Skyhawk); a heavy attack squadron, VAH-1, flying A-3 Skywarriors or A-5 Vigilantes; a photo reconnaissance detachment, VFP-62 Det; an all-weather attack detachment, VA(AW)-33 Det; an airborne early warning detachment, VAW-12 Det, flying the E-1 Tracer; and a helicopter squadron, HU-2 Det (SH-34 Seabat). An air group in the 1950s fielded between 85 and 90 aircraft.

By the early 1970s, this composition had changed, as follows: two fighter squadrons, VF-11 and VF-74, both with F-4 Phantom II;

two light attack squadrons, VA-81 and VA-83, with A-7E Corsair IIs; a medium attack squadron, VA-85, with A-6E Intruders; a reconnaissance detachment, RVAH-7, with RA-5 Vigilantes; VMCJ-2 Det.59; an airborne early warning squadron, VAW-126, operating E-2A Hawkeyes; and a helicopter squadron, HS-3, operating SH-3 Sea Kings. An air wing at this time fielded about 85 aircraft. By the 2000s, the air wing had changed to include four strike fighter squadrons, two operating the F/A-18C Hornet and two operating the F/A-18E/F Super Hornet, an electronic warfare squadron (VAQ), operating the EA-6B Prowler, and an airborne early warning squadron (VAW) operating the E-2C Hawkeye. The helicopter squadron, HCS, flew the SH-60 Seahawk. The typical CVW of the 2000s fielded about 65 aircraft and helicopters. The carrier air wing concept was altered in the 1970s to incorporate antisubmarine forces. Previously the large-deck carriers had only fighters, attack, and support aircraft, while antisubmarine warfare (ASW) was left to smaller modified Essex-class carriers operating the S-2 Tracker and various helicopters. Beginning in 1972 and continuing until the retirement of the last ASW carriers in 1974, the air wings integrated the ASW aircraft, the new S-3 Viking, into the large-deck carriers. Most carriers were modified for these aircraft and their mission during overhauls.

and more complex maintenance. Work stations were positioned around the hangar bay to facilitate repair work. To maximize space, extra fuel tanks and other supplies were often hung from the hangar ceiling.

Air group personnel operated from a series of squadron ready rooms, which were located around the ship, usually near the catapults. Two escalators were used to transport aircrews the four stories to and from the flight deck at a rate of 90ft a minute. The ready rooms were arranged by squadron, and similar types were often located in close proximity to one another.

Launch and Recovery Operations

Forrestal and *Saratoga* featured four steam-powered catapults, two C11 at the bow (numbers one and two from starboard to port) and two heavy C7 catapults at the waist (numbers three and four, starboard to port) on the port side. The port catapults were canted outward and toward one another, and permitted launches from the angled deck. Because of this positioning, however, they could not be used for simultaneous launch as could the bow catapults. The bow (forward) catapults measured 249ft (75.8m) long and could launch a 73,000lb aircraft at 215mph. The waist catapults were 211ft (64.3m) long and were limited to 70,000lb. *Ranger* and *Independence* had four C11 catapults.

At the end of catapults one and two were catapult overruns (resembling “horns”), called Van Velm bridle catchers, which facilitated the bridle system used to launch older aircraft such as the A-4 Skyhawk and F-4 Phantom II. The overruns would catch the bridle after launch, allowing for re-use. The remaining two *Forrestals* as well as the first two Kitty

Two F/A-18C Hornets launch from *Constellation's* port waist catapults numbers three and four, while another Hornet prepares to launch from the number one bow catapult in 1986. The carrier's Fresnel Lens is located on the flight deck edge near the two domed antennas. The angled deck was a British invention and was incorporated into *Forrestal's* design (US Navy).



Hawk-class carriers were built in this configuration, while *America* and *John F Kennedy* saw a third bridle catcher added for the waist catapult. These were eventually phased out as the bridle launch system was replaced by the wheel-tow launch bar system. USS *Carl Vinson* (CVN-70), a Nimitz-class carrier commissioned in 1982, was the last US carrier built with a bridle catcher.

The catapults were fired from console locations along the port and starboard catwalks, for catapults one and two, and from a singular location adjacent to catapults three and four along the port catwalk. Steam pressure for the catapults was controlled from a “pop-up” unit positioned between catapults one and two, and three and four. Steam for the catapults was provided by the carrier’s boilers at a temperature of 585 degrees and a pressure of 600psi. This was increased to 1,200psi on carriers after *Forrestal*.

Behind catapults one through three were jet blast deflectors (JBDs), which were raised at an angle to direct hot exhaust away from the flight deck during launch. The original JBDs were small slotted devices that were vertically stored in the deck such that they were raised, then rotated at 90 degrees to the launching aircraft. These were soon replaced by the larger JBDs used today, which are hinged at the forward end and can be raised to a 45-degree angle. The JBD behind catapult three was smaller than those behind catapults one and two. There was no JBD for catapult four, as the exhaust simply went off the carrier deck edge. This was later changed, beginning with *America*. All *Forrestal* and *Kitty Hawk* carriers saw their JBDs enlarged in the 1970s as a part of the modifications to accommodate the F-14s.

Carrier landings were accomplished using six arresting gears staged across the landing area of the angled deck. These were later reduced to four cables and the barricades reduced from two to one as the carriers underwent overhaul in the early 1960s. The barricade, a 21ft (6.4m) high triple rigged nylon net used to stop aircraft that could not perform a normal arrested recovery, was stored under the flight deck and could be raised in roughly two minutes.

New for the day, pilots on approach used a mirrored landing system developed by the British in the early 1950s. The system, called Magic Mirror, was originally wheel-mounted and mobile and was usually placed on the starboard side of the flight deck at about elevator number three. The system was then permanently installed on the port deck edge near the start of catapult four. Replacing the handheld “paddles” and flashlights of yesteryear, Magic Mirror greatly aided pilots in coming aboard ship and was a dramatic improvement in safety. The mirrored system was later replaced by the Fresnel Lens Visual Landing Aid system in the early 1960s. It was installed on *Forrestal* during the September 1961 to January 1962 overhaul. The Fresnel Lens system consisted of a set of reference lights (datum lights), a flight path indicator light located between the datum lights, and additional signal lights to give the pilot a “cut” signal (reduce power and land) or a “wave-off” signal (add power and fly around for another approach). When an aircraft was high on its flight path, the flight path indicator light (the “meat ball”) appeared high with

A frontal view of USS *Saratoga* shows the two forward bridle catchers and the full run view of the number two catapult. The communications along the starboard side of the flight deck are elevated for use (US Navy).



reference to the datum lights. When the aircraft was on its desired flight path, the meat ball was perfectly aligned.

Approaching aircraft were controlled by the LSO, who called the approach from a small port-side platform (LSO Platform). The LSO was an experienced aviator who talked to the aircraft on approach and provided slight adjustments, and who also controlled the cut and wave-off lights on the Fresnel Lens. LSOs went through a complex school and spent countless hours “calling” aircraft ashore before being permitted to do so at sea.

Stores

The Forrestal class carried a large quantity of aviation fuel, some 750,000 gallons. Fuel was dispensed to aircraft at any of 40 receptacles on the flight deck. At first the aviation fuel included a mix of jet fuel and aviation gas, but the latter was discontinued after piston-engined aircraft left service in the 1960s. To support the air group, roughly 2,000t of ammunition was stored in armored magazines, which were accessed from the flight deck via small elevators. The carrier also stored over 7,800t of fuel for the ship. The storerooms on the carrier were the equivalent of a six-story, one-block-square warehouse and had a cumulative capacity of 408,325 cubic ft. There were also 257 inflatable lifeboats capable of embarking the entire crew. The inflatable lifeboat was later replaced by a new lifeboat in a pod, which automatically deployed upon striking the water.

Defensive Systems

Forrestals were initially outfitted with eight Mk 12 single-mount 5in/38 caliber guns positioned on sponsons, four forward and four aft. The forward guns and sponsons were removed from three of the ships at various points during the 1960s because they interfered with ship handling in heavy seas, especially in the North Atlantic. High seas often damaged the guns and sponsons and rendered the guns useless. *Ranger* retained its sponsons until decommissioning.

All remaining aft guns were removed by 1977 and replaced by twin Mk 10 RIM-2 Terrier surface-to-air missile launchers. Each unit had a 40-round rear-loading magazine. Possessing a 218lb (99kg) controlled-fragmentation warhead, the RIM-2A/B was one of the first surface-to-air missiles and was originally deployed with a beam-riding guidance system, having a range of 10nm (11.5m). It was upgraded to the RIM-2E, which featured semi-active radar homing guidance and had a range of 40nm (46.03m). The Terrier system

was first replaced by the Standard Missile, and then by the NATO Sea Sparrow Basic Point Defense Missile System (BPDMS), which originally included eight-missile Mk 25 launchers and subsequently Mk 29 launchers.

Forrestal carriers were also fitted with at least two Mk 15 Phalanx Close-In Weapons Systems (CIWS) when they underwent Service Life Extension Program (SLEP) modifications in the 1980s. CIWS consisted of a 20mm M61 Vulcan Gatling gun mounted on a

A forward-quarter starboard Mk 25 NATO Sea Sparrow launcher releases a RIM-7 Sea Sparrow missile. The missile measures 12ft (3.64m) and packs a 90lb (40.5kg) annular blast fragmentation warhead. The small barrel-like objects along the flight deck are lifeboats that automatically open when they strike the water (US Navy).



swivel base. Ammunition was stored in a large white cylinder located above the gun, which subsequently spawned the nickname “R2-D2” from the movie *Star Wars*. CIWS was developed in the 1970s and began appearing on aircraft carriers in the early 1980s when they were in port for scheduled work, beginning with USS *Coral Sea* in 1980. Most carriers had three CIWS units.



Electronic Systems and Radar

The mast, radar, and communications antennas were located on the carrier island superstructure. This configuration provided much better radar coverage than the layout in the original design, which called for a series of radars to be located around the carrier and merged into one radar picture. *Forrestal*'s radar systems at commissioning were simple by today's standard. Air search was provided by the SPS-8A and SPS-12 (2-D) radar. *Saratoga* and *Ranger* shared this configuration, although *Independence*, the last of the class, received the newer SPS-8B and SPS-37A (2-D). These radars were replaced in the early 1960s by the SPS-43A (2-D) and SPS-30 (3-D), which assumed the duties of the SPS-8A/B and SPS-12. All use the SPN-10 navigation radar. By the mid-1970s, all were operating the SPS-48 (3-D) and SPS-49 (2-D) air search radar.

A 1950s-era image of *Forrestal* shows vintage F9F Cougars and F2H Banshee jets. Notice the Mk 12 5in/38-caliber gun mounts of the forward sponsons (Naval Aviation Museum).

Propulsion

The carrier was powered by eight Babcock and Wilcox boilers and four Westinghouse geared turbine engines, generating 260,000 shaft horsepower. Because *Forrestal* was built under rather urgent time constraints, the engine machinery was limited in steam conditions to wartime figures of 600psi and



USS *Ranger* (CVA-61) steams in this 1950s image. It still has the 5in/38-caliber guns mounted on its forward sponsons. These sponsons were never removed from *Ranger*, although the remaining carriers in the class had theirs detached (US Navy).

SLEP

Faced with budget issues and the high cost of nuclear-powered carrier construction, the Navy developed a program in 1979 to extend the useful life of its carrier fleet. Referred to as SLEP, the Service Life Extension Program scheduled all *Forrestal*- and *Kitty Hawk*-class carriers to undergo a complex 28-month modernization program to add ten to 15 years of service life. Although *Forrestal* was to start the process in early 1980, *Saratoga* was actually the first carrier to undergo SLEP (September 1980 to May 1983). *Forrestal* followed from January 1983 to May 1985, and *Independence* from February 1985 through August 1989. *Ranger* was the only ship of the class not to undergo SLEP,

although it received a complex overhaul. Two of the three *Kitty Hawk*-class carriers underwent SLEP during the late 1980s and early 1990s; *Kitty Hawk*, from July 1987 to August 1990; *Constellation*, from July 1990 to March 1993; and *John F. Kennedy*, commencing in 1995. *America*, although scheduled for SLEP in the mid-1990s, was retired instead. SLEP was an opportunity to modernize electronics and weapons systems and make changes to the flight deck. For example, during *Forrestal*'s 1983–85 SLEP, it received new arresting gear, had all Sea Sparrow launchers updated to Mk 29 standards, and saw the addition of an ASW Tactical Support Center. Catapult number four was also extended by 42ft (12.8m).



A crisp image of *Forrestal*'s island highlights the various antennas. The square black radar above the bridge is the AN/SPS-48 3-D air search radar. The two radars on the second-from-the-top platform, from right to left, are the SPS-67 surface search radar and the SPN-43A CCA radar. The bridge windows angle to allow a better view of the flight deck (US Navy).

850 degrees of super heat, resulting in the reduced horsepower. These figures were later changed, from *Saratoga* onward, to reflect standard postwar conditions of 1,200psi and 950 degrees, which increased overall power to 280,000shp at the cost of a minimal increase in weight and resulted in a significant improvement in fuel consumption. The carrier's engines drove four propellers, two five-blade and two four-blade, each measuring 21ft in diameter and weighing 45t. The carrier was capable of a top speed of 33kt (38mph). As built, *Forrestal* possessed three rudders, although this practice was discontinued on subsequent carriers.

THE FORRESTAL CARRIERS

Since it is possible to write an entire book on each carrier's deployments, the following summaries highlight the more significant operational achievements of the various Forrestal-class carriers. In all respects it should be noted that the Forrestal carriers played a vital role in advancing the development of naval aviation and in projection of American power during the height of the Cold War.

USS *Forrestal* (CVA-59)

USS <i>Forrestal</i> (CVA-59)	
Funding authorized	Fiscal Year 1952
Keel laid	July 14, 1952
Launched	December 11, 1954
Commissioned / Decommissioned	October 1, 1955 / September 11, 1993
Nickname	<i>FID</i> – <i>First in Defense</i> ; unofficially termed the <i>Zippo</i> and <i>Forrest Fire</i> due to several shipboard fires, most notably that of 1967.

Named for the first Secretary of Defense and former naval aviator James V. Forrestal, this carrier was authorized on July 12, 1951, and work began on its keel one year later at the Newport News Shipbuilding and Drydock Company in Newport News, Virginia. *Forrestal* was launched on December 11, 1954, and commissioned on October 1, 1955, with Capt R. L. Johnson as its commanding officer. The carrier was originally designated as CVA for attack carrier, but was re-designated as a “general purpose” carrier, CV-59, in June 1975, when the carrier incorporated the antisubmarine mission via addition of the S-3A Viking and SH-3 Sea King.

Initially home-ported at Norfolk, *Forrestal* spent its first year in intensive training operations off the Virginia Capes and in the Caribbean, familiarizing

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USS *SARATOGA* WITH S-3 VIKING

An S-3 Viking launches from USS *Saratoga* (CVA-60) on a routine antisubmarine patrol. The Viking joined the carrier air wing in the mid-1970s and assumed the organic antisubmarine warfare (ASW) role previously undertaken by the ASW-dedicated modified Essex-class carriers. The Viking was incorporated in the attack air wing in the mid-1970s as part of the new CVW concept. The Viking evolved into a formidable surface warfare aircraft and a fleet tanker, and also performed overland surveillance.





An RA-5 Vigilante prepares to launch from USS *Forrestal* during flight operations in 1967. The air wing features both A-4 Skyhawks and A-6A Intruders (US Navy).

USS *Forrestal* (CVA-59) is seen here in the early 1960s with a combination of A-4 Skyhawks (catapult number one), F-4 Phantoms (catapult number two), AD-1 Skyraiders (angled deck landing area), and F-8 Crusaders (waist catapults) (US Navy).



the aircrews and deck crews with air operations on the larger flight deck. *Forrestal* made its first deployment to the Mediterranean in January 1957 as part of the Sixth Fleet. After making several additional Mediterranean deployments over the next few years, in November 1963 it made history by conducting operations with a C-130F cargo transport. Over the course of three days, a three-person crew led by Lt James H. Flatley III conducted 21 full-stop landings and take-offs from *Forrestal*. These tests, part of the Navy's efforts to develop a "Super COD (Carrier On-board

Delivery aircraft)," marked the largest and heaviest aircraft ever to operate from a carrier deck. At the time, no aircraft had sufficient range to replenish carriers mid-ocean.

The 85,000lb (42.5t) C-130F (BuNo. 149798) came to a complete stop within 267ft (81m) and was able to take-off in 745ft (227m). The tests demonstrated that the aircraft could transport 25,000lb (11t) of cargo over 2,500 miles (4,000km), which clearly met the Navy's needs. However, the program was considered too risky for routine operations and was canceled; the direct offshoot was the C-2 Greyhound program.

In 1967, *Forrestal* arrived in the Tonkin Gulf and began air operations over North Vietnam on July 23. Four days later, a Zuni rocket from an F-4 Phantom on deck misfired into a parked A-4 Skyhawk, breaking open the Skyhawk's 400-gallon external fuel tank and starting a horrendous fire that consumed 21 aircraft, resulted in 134 dead and 161 injured, and caused over \$72 million in damage. The carrier sustained over a dozen major detonations from 500lb and 1,000lb bombs, missiles, and hundreds of gallons of burning jet fuel. *Forrestal* returned to the United States for repairs, surviving the most damage ever caused to an American aircraft carrier.

The carrier returned to duty and made another four deployments to the Mediterranean between 1968 and 1975. During this time the new S-3 Viking conducted carrier qualifications aboard *Forrestal*. In July 1975, *Forrestal* participated in a special shock test where high explosives were detonated near the hull to examine how carriers withstood the strain of close quarter combat. Following a nine-month major overhaul, in September 1977, the Navy changed its homeport to Mayport, Florida, and the following year the ship participated in a major NATO exercise, *Northern Wedding*, which involved practicing the reinforcement and resupply of Europe in the event of war.

Forrestal continued to make regular Mediterranean deployments until it entered Selected Restricted Availability in September through November 1990, and underwent modifications to allow it to operate the F/A-18 Hornet and H-60 Seahawk. As *Desert Storm* neared, the carrier served as the "ready carrier" in preparation for deployment to the Persian Gulf. Although it was called up twice, it was never deployed in support of combat operations. The

carrier made its 21st and final deployment in May 1991, finishing its career with over 376,500 arrested landings recorded.

In early 1992 *Forrestal* began serving as a training carrier, replacing USS *Lexington* (AVT-16). Later that year it entered a 14-month complex overhaul, but in early 1993 the Navy decided to decommission *Forrestal* and to discontinue a dedicated training carrier. The world's first supercarrier was officially decommissioned on September 11, 1993. Since then, efforts to make it into a museum have failed. *Forrestal* was stored at Newport, Rhode Island, until October 2013 when it was sold for scrap.

USS *Saratoga* (CVA-60)

USS <i>Saratoga</i> (CVA-60)	
Funding authorized	Fiscal Year 1953
Keel laid	December 16, 1952
Launched	October 8, 1955
Commissioned / Decommissioned	April 14, 1956 / August 20, 1994
Nickname	<i>Sara</i> ; <i>Super Sara</i>

CV-60 was the sixth ship and second aircraft carrier to bear the name *Saratoga*. Named for the Revolutionary War battle, the carrier was commissioned in April 1956 under the command of Capt Robert Joseph Stroh. Built in the New York Navy Shipyard, the carrier made its initial deployment in 1957 to the North Atlantic, participating in Operation *Strikeback*, a major NATO naval exercise simulating an all-out Soviet attack on Europe.

Saratoga made the majority of its deployments to the Mediterranean, but did participate in the Cuban Missile Crisis in October 1962. On June 24, 1969, an F-4 Phantom II crew from VF-103 made the first operational “hands off” carrier arrested landing using the AN/SPN-42, Automatic Carrier Landing System (ACLS). In 1972, *Saratoga* made its only Vietnam deployment, operating on Yankee Station from May 18 through January 7, 1973. During this period a VF-31 F-4 Phantom crew downed a North Vietnamese MiG-21. The carrier thereafter continued to deploy to the Mediterranean on an almost annual basis, in each instance with Carrier Air Wing 17 (CVW-17).

During its 1980 Mediterranean cruise with CVW-17, then-commanding officer, Capt James H. Flatley III, made his 1,500th carrier arrested landing with his son, then a midshipman, in the aft cockpit. Shortly after that cruise, *Saratoga* entered the Philadelphia Naval Shipyard for what was then the most extensive overhaul ever performed on a Navy ship, a 28-month SLEP. When the carrier departed for sea trials, it was given the new nickname, “*Super Sara*.” Following this SLEP, the carrier operated the new F-14 Tomcat rather than the F-4J. *Saratoga* was also involved in operations off Libya in 1986, even conducting strikes against Libyan patrol boats, but left the area before the *El Dorado Canyon* raids. During the deployment *Saratoga* also provided air cover for the interception of the *Achille Lauro* hijackers.

USS *Saratoga* (CV-60), shown here during flight operations in the 1980s, displays a combination of A-6E Intruders, A-7E Corsair IIs, and F-14A Tomcats. Both forward JBDs are elevated for launching the Tomcats. *Saratoga* was renowned for engine problems that plagued its entire career (US Navy).



The carrier deployed in support of Operations *Desert Shield* and *Desert Storm* in late 1990 and early 1991, with two F/A-18Cs from VFA-81 downing Iraqi MiGs on the opening night of the war. The carrier also held the unwanted distinction of being the first to lose a naval aviator to enemy action in the conflict when LtCdr Michael Speicher's F/A-18 was lost. The air wing also lost an F-14A from VF-101, although both crew survived.

The carrier began its 22nd and final deployment in January 1994, departing with CVW-17 for the Adriatic Sea to support air operations over Bosnia-Herzegovina. *Saratoga* returned to Mayport and was decommissioned on August 20, 1994. It was towed to Philadelphia Naval Yard the following spring to join the inactive fleet and was subsequently moved to Newport, Rhode Island, where it remains today awaiting disposal. The carrier recorded over 300,000 arrested landings.

USS *Ranger* (CVA-61)

USS <i>Ranger</i> (CVA-61)	
Funding authorized	Fiscal Year 1954
Keel laid	August 2, 1954
Launched	September 29, 1956
Commissioned / Decommissioned	August 10, 1957 / July 10, 1993
Nickname	Top Gun

The second aircraft carrier bearing the name *Ranger*, CVA-61 was launched from the Newport News Shipyards on September 29, 1956. *Ranger* was the first carrier built from the start as an angled deck carrier. Although initially deployed to the Atlantic Fleet and operating out of Norfolk, *Ranger* moved to Alameda, California, in August 1959 and remained a Pacific Fleet carrier for the remainder of its career. Most of the carrier's subsequent deployments were Western Pacific (WestPac) deployments, although some focussed more specifically on the Indian Ocean and later the Persian Gulf. In 1963–64, while being overhauled, *Ranger* had 8ft (2.43m) added to the width of its flight deck to accommodate newer aircraft.

In May 1964, while observing the French nuclear detonation at Moruroa in the Pacific, *Ranger* launched a U-2 spy plane from its deck. Reportedly the launch was deemed so secret that the flight deck personnel were sent below deck for the launch. The following year the carrier made the first of seven deployments to the waters off Vietnam. In 1967, the carrier was the

first to deploy with the new A-7 Corsair II – a light bomber designed to replace the A-4 Skyhawk – the EKA-3B Skywarrior, and the UH-2C Seasprite helicopter. In March 1971, *Ranger* and *Kitty Hawk* set a record of 233 strike sorties launched in a single day. In 1972, it participated in *Linebacker II* air operations along with *Enterprise*, *Saratoga*, *Oriskany*, and *America*.

The carrier was again in combat during *Desert Storm*; a VF-1 F-14A shot down an Iraqi Mi-8 helicopter. The following year *Ranger* participated in the 50th anniversary

USS *Ranger* (CV-61) as it appeared upon its return from Operation *Desert Storm* in March 1991. The forward sponsons are clearly visible here. *Ranger*'s lower island was painted black at this time. By now the carrier had only one bridle catcher remaining (US Navy).



of the Doolittle Raid on Tokyo by launching two World War II-era B-25 Mitchell bombers. During its final deployment, the carrier provided air support for Operation *Restore Hope* and covered the Army Ranger operations in Somalia. Following completion of its 21st deployment in 1992, *Ranger* was decommissioned on July 10, 1993, and is currently in storage in Bremerton, Washington. *Ranger* earned 13 battle stars in Vietnam and was seen in several movies, including *Top Gun*, *Star Trek IV*, *The Final Countdown*, and *Flight of the Intruder*. *Ranger* was the only carrier in its class to retain its forward sponsons and not to undergo SLEP.



A starboard side view of *Ranger*'s island is seen here; notice the white Mk 15 Phalanx CIWS near the flag bridge (US Navy).

USS *Independence* (CVA-62)

USS <i>Independence</i> (CVA-62)	
Funding authorized	Fiscal Year 1955
Keel laid	July 1, 1955
Launched	June 6, 1958
Commissioned / Decommissioned	January 10, 1959 / September 30, 1998
Nickname	Indy

The fifth United States ship to carry the name *Independence*, CVA-62 was built at the New York Naval Shipyard and was launched on June 6, 1958. Capt R. Y. McElroy was the first commanding officer. Following its shakedown cruise in the Caribbean and suitability trials during 1959, the carrier deployed from Norfolk to the Mediterranean in August 1960. *Independence* provided air support during the 1962 Berlin Crisis and during the Cuban Missile Crisis and performed air strikes against North Vietnam during 1965.

The carrier made numerous Mediterranean deployments during the 1970s and, in early 1980, served there with three other US carriers supporting an international peacekeeping force off Lebanon. In 1983 *Independence* supported Operation *Urgent Fury*, the liberation of Grenada, and later returned to Lebanon to conduct air strikes against Syrian positions. *Independence* underwent a SLEP in February 1985 until June 1988, and then relocated to the Pacific Fleet, home-porting in San Diego. In 1990, *Independence* and CVW-14 arrived in the Gulf of Oman to provide air support for Operation *Desert Shield* following the Iraqi invasion of Kuwait. *Independence* was on station for nearly three months before returning to port in late December.

In September 1991, *Independence* and CVW-5 forward deployed to Yokosuka, Japan, replacing USS *Midway*. The carrier remained there until 1998, when it was replaced by USS *Kitty Hawk*. *Independence* was decommissioned on September 30, 1998, after 39 years of service. The carrier was heavily stripped to support other active

USS *Independence* (CVA-62) was the last of the Forrestal-class carriers. This image shows how the forward sponsons were removed. The lead aircraft on the flight deck is an A-7E Corsair II light attack bomber (US Navy).



carriers and its port anchor and both anchor chains were used on USS *George H. W. Bush* (CVN-77). *Independence* is stored at the Puget Sound Naval Shipyard, Bremerton, Washington, and is scheduled to be scrapped.

THE KITTY HAWK CLASS

The Forrestal-class carriers were authorized in 1951 for shipbuilding program FY52, which called for the construction of one new carrier every year thereafter. Work on *Forrestal* commenced in July 1952, with *Saratoga*, *Ranger*, and *Independence* following each year. In late 1952 BuShips told SecNav that the first true opportunity to consider carrier redesign would come in the FY55 building program (CVA-62). BuShips noted that the need to complete the carriers then under construction on time outweighed the need for any type improvements. On the horizon were nuclear propulsion and considerations of costs, which were already growing with the Forrestals – the next Forrestal was estimated at \$215 million.

As part of this process, Navy planners considered an improved *Midway*-sized carrier of roughly 44,500 long tons (designated CVA-3/53), an improved version (CVA-10/53), and a larger CVA design able to handle aircraft of up to 100,000lb. These studies confirmed that such alternative carrier designs were possible given the aircraft of the day (circa 1953), but that each would soon prove impractical as aircraft grew. As a result, the decision was made to continue with the Forrestal design, or some variation thereof, and to modify the carriers as needed to accommodate the larger aircraft.

Given this realization, planners then turned their attention to improvements in aircraft operations – more powerful arresting gear; relocating aviation gas and munitions forward; elimination of the centerline rudder; and modifications to the flight deck and waist catapults. Of these proposals, only a few could reasonably be developed in time for inclusion in the FY55 carrier, CVA-62, which meant some of the proposals would have to wait for the next construction. Nevertheless, both FY54 (CVA-61) and FY55 (CVA-62) carriers received more powerful waist catapults.

Over time, these designs evolved and were given the designation SCB-127 and generally applied to the FY56 carrier, ultimately becoming USS *Kitty Hawk*

(CVA-63/SCB-127A). The next two supercarriers, CVA-64 *Constellation* and CVA-66 *America*, were also in this class. Central to this redesign was re-arrangement of the carrier flight deck; the island structure was moved aft, ahead of one elevator and aft of starboard elevators one and two. Moreover, the port elevator (number four) was moved aft and out of the angled flight deck, which permitted elevator use during recovery operations and launch operations from the waist catapults. This repositioned elevator could then

This shows a menacing view of *Kitty Hawk* as it steams ahead in the open ocean. This perspective gives a full view of the carrier's beam and the various sponsons supporting the island and angled flight deck (US Navy).





service the waist catapults, while elevators one and two could service the bow catapults. Elevator three, aft of the island, could be used to remove aircraft from the deck after recovery to complement elevator four in servicing the waist catapults. In addition to the flight deck re-arrangement, the elevators were also enlarged to accommodate the A-3 and A-5 aircraft. A pie-shaped segment was added to each elevator's outboard edges and became standard on all Kitty Hawk-, Enterprise-, and Nimitz-class carriers.

This 1983 starboard profile view of USS *America* (CVA-66) shows the location of the hangar bay elevators. Note the Mk 10 Terrier launchers have been replaced with Mk 25 BPDMS Sea Sparrow launchers (US Navy).

Major Differences from the Forrestal Class

Apart from the re-arranged flight deck and enlarged elevators discussed above, the principle differences between the Forrestal class and Kitty Hawk class were largely internal. The first two carriers of the class, CVA-63 *Kitty Hawk* and CVA-64 *Constellation*, were largely the same design, although some differences existed, as noted below. USS *America* (CVA-66) was an improved Kitty Hawk and USS *John F. Kennedy* (CVA-67) was a class on its own, and both were originally planned as nuclear carriers.

Defensive Armament

One of the most prominent physical differences was the ship defensive armament, which began with the substitution of Terrier missile surface-to-air systems for the previous 5in mounts used on the Forrestal class. The two forward guns and sponsons were eliminated and the aft guns replaced by twin Mk 10 Terrier launchers. These launchers were subsequently removed and replaced by Sea Sparrow BPDMS launchers. Terriers were replaced by Sea Sparrows on *Kitty Hawk* in 1977, and on *Constellation* and *America* in 1979–82. All of the carriers were given a third Sea Sparrow launcher by 1990.

The elevators were notched to allow carriage of the larger A-3 Skywarrior and A-5 Vigilante aircraft. Here a VF-2 *Bounty Hunter* F-14 Tomcat is brought to the flight deck on *Constellation* (US Navy).

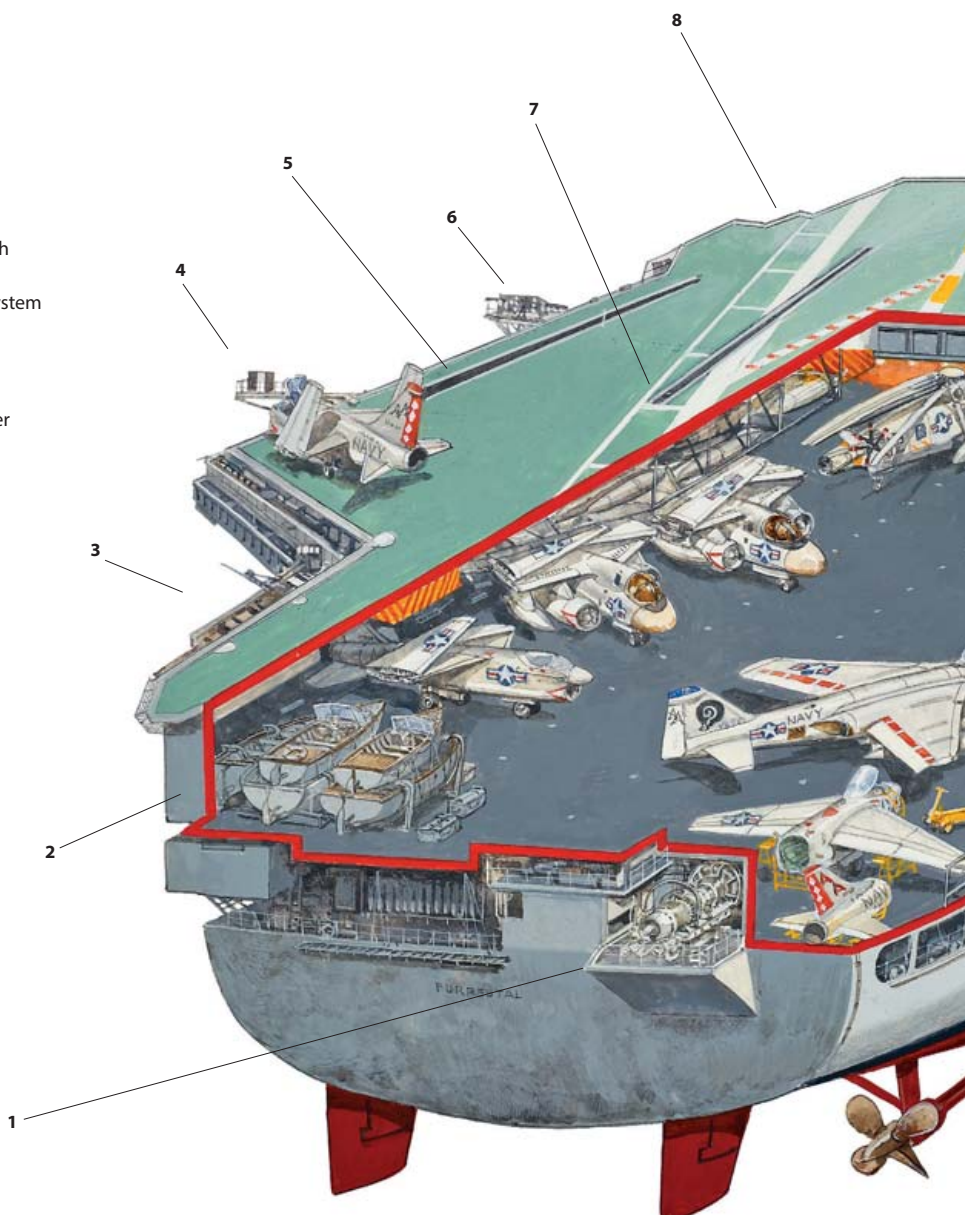
The three carriers each possessed the RIM-2 Terrier missile system, which necessitated installation of the SPG-55 tracking/illumination missile guidance radar antennae. The Terrier missiles were later replaced by the RIM-67B Standard and even later by Mk 25, then Mk 29 launchers with RIM-7 Sea Sparrows. The latter served as a point missile defense system against low-flying cruise missiles. Fire control was initially provided by the Mk 115 illuminator and subsequently the Mk 95, which had automatic guidance and could be used in all weather conditions. A third launcher was later added to the Kitty Hawk carriers and located starboard.

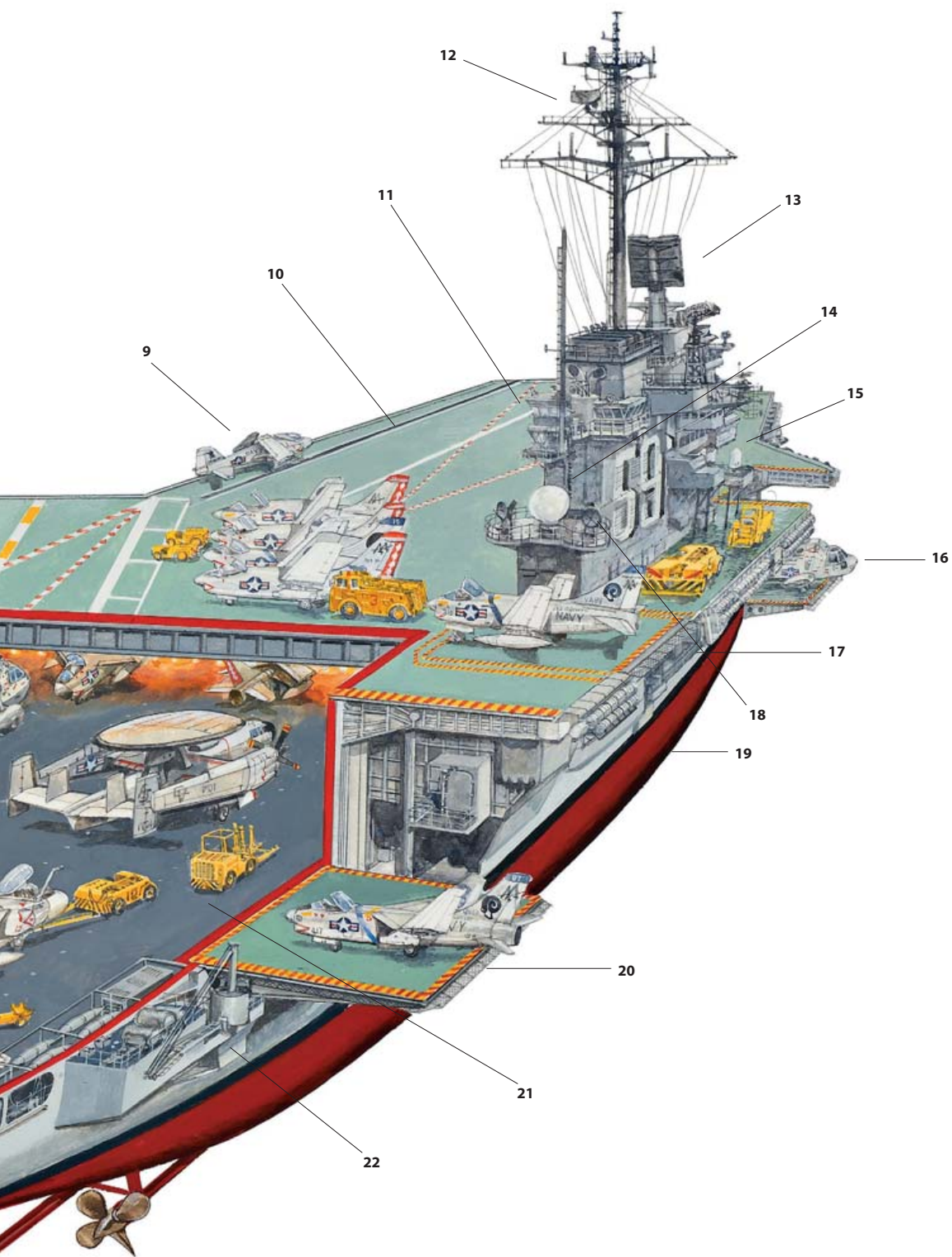
Additional last-line close-in defense was provided by the Phalanx Close-In Weapon System (CIWS). As with



KEY

1. Engine test area
2. Captain's boat/Admiral's boat
3. LSO platform
4. Vought A-7E Corsair II
5. Catapult No. 4
6. Fresnel lens
7. Catapult No. 3
8. Elevator 2
9. Grumman EA-6B Prowler
10. Catapult No. 2
11. Primary Flight (Pri-Fly)
12. SPS-67 radar
13. AN/SPS-48 3D air search radar
14. SPN-35A carrier-controlled approach (CCA) radars
15. Mk 15 Phalanx Close-In Weapons System (CIWS)
16. Elevator 1
17. Elevator 3
18. SPN-42 CCA ACLS (automated carrier landing system) radars
19. Double hull
20. Elevator 4
21. Aft hangar bay
22. Ship's crane







USS *America* (CV-66) is shown here in dry dock at Norfolk Virginia for overhaul during 1982. All three Van Velm bridle catchers are shown, as is the forward-quarter port-side Mk 15 Close-In Weapon System (CIWS). A NATO Sea Sparrow launcher is located opposite the CIWS on the starboard side (US Navy).

The carrier hangar bay measures roughly 75,000sq ft. This image from USS *Kitty Hawk* during Operation *Enduring Freedom* shows a replenishment underway (US Navy).



the Forrestal carriers, these were added to *Kitty Hawk* and its follow-ons in the 1980s during overhauls. *Kitty Hawk* and *Kennedy* also received at least one of the new RIM-116 Rolling Airframe Missiles (RAMs), four Mk 36 Super RBOC (Rapid Blooming Off-board Chaff) chaff/infrared decoys, and towed SLQ-25 Nixie torpedo decoys. CVA-67, USS *John F. Kennedy*,] Terrier launchers, was built with no guns or heavy missile batteries.

Rather, provisions were made for installation at a later date of three new short-range basic point defense missile systems (Sea Sparrow or BPDMS), which were added in 1967.

As an interesting note, during the mid-to-late 1950s three of the Forrestal-class carriers were planned to carry the nuclear-armed turbojet-powered cruise missile, the SSM-N-8A Regulus; of these three, only *Saratoga* actually launched a Regulus. This capability was removed once the A-3D Skywarrior and A-4 Skyhawk attack aircraft, which were nuclear-strike capable, were deployed in large numbers.

Dimensions and Displacement

The early *Kitty Hawk* carriers had a standard displacement of 60,100t, with a deep load displacement of 80,800t. Fully loaded, the early *Kitty Hawks* had a deep draft just 15in less than the Forrestals. From a flight deck perspective, *Kitty Hawk* measured 1,062ft 6in (323.8m), while *Constellation* was 10ft longer. Both had a 249ft (75.8m)-wide flight deck and measured 129ft 6in (39.5m) abeam.

Propulsion

Owing to improvements in technology, *Kitty Hawk*, *Constellation*, and *America* featured a larger power plant (280,000shp), which supported 1,200psi, and in turn improved catapult performance. Given the larger power plant, these carriers could reach a top speed of 35kt (40.27mph). Recognizing the need for more fuel to support air operations (and the need for more fuel for newer jets), the *Kitty Hawk*-class carriers carried 1,900,000 gallons of aviation fuel, more than twice that of Forrestals.

Electronics and Radars

The original radar suite for the first two *Kitty Hawk* carriers comprised the SPS-37A air search, SPS-39 (3-D) air search, SPS-8 height-finding radar, and SPS-55 missile guidance radar for the Terriers.

America, discussed below, had the SPS-43 VHF long-range air search radar and the SPS-52 (3-D) long-range air search radar antenna on the island. The SPS-43 (2-D) radar had a range of over 300 miles and provided bearing and distance information, while the SPS-52 (3-D) radar could provide contact bearing, range, and altitude. The SPS-52 could be mechanically rotated for azimuth but used electronic scanning for elevation. The two radars would work together, with the SPS-43 picking up the contact at distance and the SPS-52 providing details as the contact approached.

An SPS-30 surface search radar antenna was located on the new lattice work mast aft of the main mast. Each ship was also fitted with TACAN (TACTical Airborne Navigation) aids. *John F. Kennedy* carried a smaller suite of the SPS-43A and the new SPS-48 (3-D) long-range air search radar. *America*'s SPS-52 was replaced with the more capable SPS-48 radar in 1982 and all ships in the class saw their SPS-43A replaced with the SPS-49 during 1979–80.



The barricade is used to stop aircraft that cannot recover using a tailhook. On *America* and *John F. Kennedy*, Pri-Fly was later moved forward on the island (US Navy).

USS *America*, CVA-66 – Improved Kitty Hawk

The final carrier of the class, USS *America*, was similar to its two sisters and, due to the time between the construction of CVA-63 (FY56) and 64 (FY57) and *America* (FY61) (in part because of the construction of *Enterprise*), was sometimes considered an improved Kitty Hawk. The carrier was the first to feature the bulbous bow-mounted SQS-23 sonar. The sonar was included to help combat the quieter Soviet nuclear submarines then being fielded. To ensure the anchors did not interfere with the sonar, a modification was made, adding a small beak on the bow. While *America* had two anchors, the port anchor was moved to the center of the bow (stem), where the beak moved it forward and prevented it from contacting the sonar bulb.

America was also fitted with a narrower smoke stack, which reduced turbulence and kept exhaust gasses away from the flight deck. The island superstructure configuration was also altered, moving the Pri-Fly from the aft end of the island to atop the navigation bridge on the front of the island. *America* was a slightly smaller carrier than *Kitty Hawk* and *Constellation*, measuring 1,047ft 6in (319.3m) in length, but possessed a wider hull than its two predecessors, measuring 130ft (39.6m). As a final physical difference, *America* featured smooth or “rounded” sponsons, versus the boxier ones in earlier Forrestal and Kitty Hawk designs. This provided a more stable transit, especially in rough waters.

USS *John F. Kennedy*, CVA-67 – A Singular Class

Although sometimes referred to as a member of the Kitty Hawk class, USS *John F. Kennedy* was an improved Kitty Hawk and is considered to have been a single-ship class. As late as 1963, the carrier was planned as nuclear powered, but was reconfigured as a conventional carrier for cost reasons. Based on *America*, the *Kennedy* had many modifications that made it unique. For example, the flight deck had numerous revised contours that resembled those



TOP This forward-quarter starboard view of *America* shows a Tomcat preparing for launch with a large portion of the remaining air wing on deck. The forward sponson has an eight-tubed Mk 25 NATO Sea Sparrow launcher. A group of six S-3A Vikings are located center-deck between the forward elevator and island (US Navy).

BOTTOM Notice the sponsons under the elevators on USS *Kitty Hawk* and how those differ from the more contoured sponsons on USS *America* in the previous photograph (US Navy).

found on subsequent Nimitz-class carriers, and the smoke stack was canted outward to help direct gasses and smoke away from the flight deck. Moreover, while using the CVA-66 hull as a starting point, *Kennedy* incorporated several of the protective armor features from *Enterprise*. Although the carrier was provisioned for the bow-mounted SQS-23 sonar, as was *America*, it was never installed.

Kennedy's flight deck was 3ft wider (at 252ft/76.8m) than the preceding Kitty Hawk carriers but had a standard displacement of only 61,000t and a deep load displacement of 87,000t. The overall length was 1,072ft (326.7m) and the hull beam was 130ft (39.6m). The carrier stored more jet fuel and more ammunition than prior carriers and all squadron ready rooms were moved to the 03 Level Galley deck, eliminating the need for the escalators.

Kennedy featured three C13 catapults (numbers one, two, and four), which had a run of 250ft (76.2m). Catapult three was a more powerful C13 Mod 1 catapult, measuring 310ft (94.4m) and enabling launch of the heaviest aircraft even at anchor with no wind over deck. As with *America*, catapult four had a smaller one-piece JBD. From a superstructure standpoint, the island, apart from the canted smoke stack, resembled that of *America*, with the flag bridge on 08 Level, navigation bridge on 09 Level, and Pri-Fly on 10 Level.

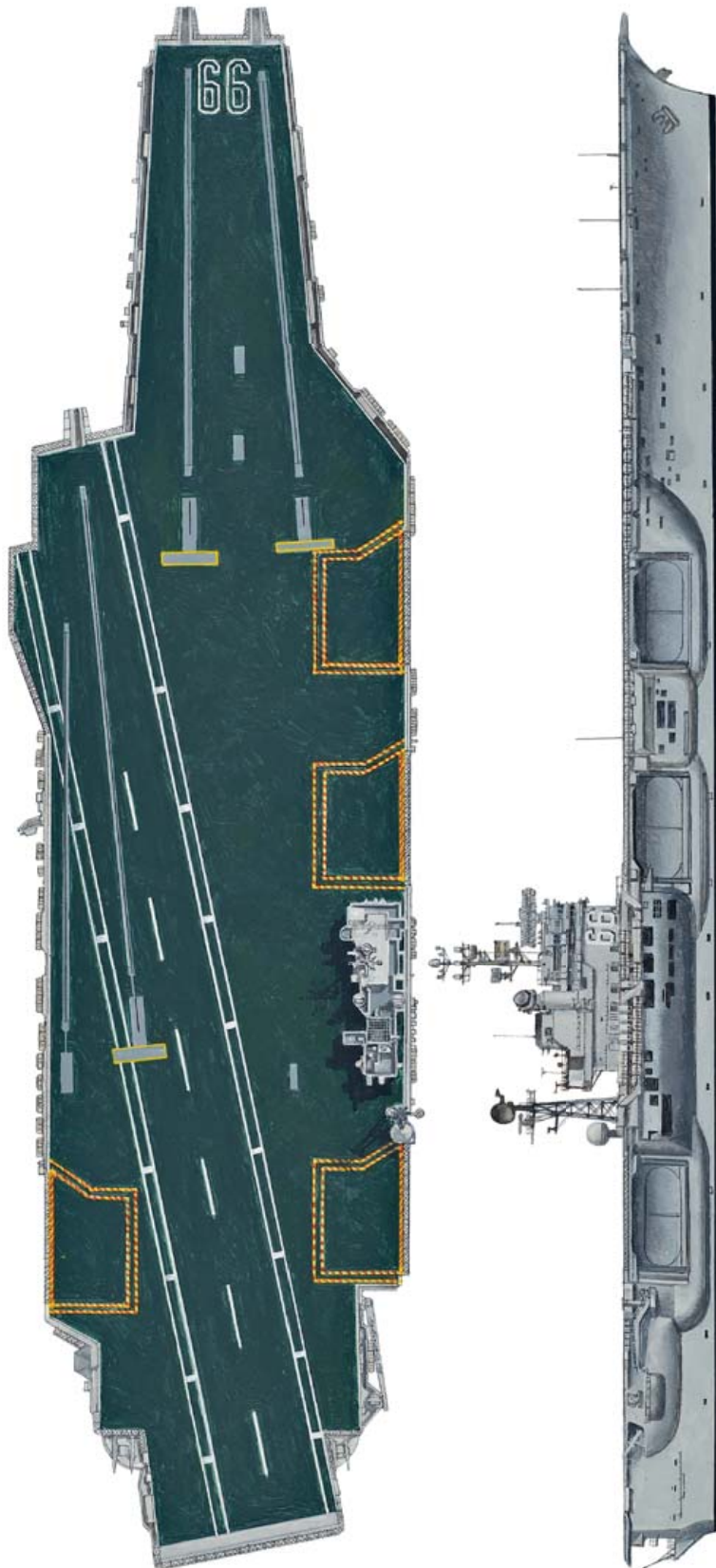
Although consideration was given to installing the proposed (but canceled) RIM-50 Typhon LR and then the less-capable RIM-24 Tartar surface-to-air missile, *Kennedy* was commissioned without any weapons. However, in 1967 three BPMDS Sea Sparrow systems were added; one eight-missile Mk 25 launcher was located near the starboard bow and one was positioned on each of the aft quarters. Three Mk 15 CIWS were also installed during the 1980s, one on *Kennedy's* port bow quarter, a second on the starboard island, and a third on the aft stern quarter. As with the other carriers in the Forrestal and Kitty Hawk classes, several Mk 36 Rapid Bloom Off-Board Chaff Support (RBOC) launchers were positioned around the carrier for defense against radar-guided missiles.

A second *Kennedy*-class carrier was considered in the late 1970s as a more affordable alternative to the increasingly expensive Nimitz-class constructions. At that time, a new *Kennedy* was evaluated versus a fourth Nimitz (recently defunded) and also a new design called Aircraft Carrier – Medium or CVV. This design, at 52,200t, was 912ft (278m) long and 126ft (38.2m) abeam, featured two catapults and two elevators, and could operate between 55 and 65 Vertical/Short Take-Off and Landing (V/STOL)

D

USS AMERICA

America featured a modified island structure and a bulbous bow section to accommodate a new sonar system, but was otherwise similar in construction to its sisters *Kitty Hawk* and *Constellation*.



and conventional aircraft. Both CVV and another Kennedy were rejected by the Carter Administration in favor of USS *Theodore Roosevelt* (CVN-71).

THE KITTY HAWK AND JOHN F. KENNEDY CARRIERS

As with the summary on the Forrestal class, the following highlights the significant contributions made by each Kitty Hawk-class carrier during the Cold War and beyond. Unlike the Forrestals, which were all retired within a few years of the end of the Cold War, *Kitty Hawk* and the improved Kitty Hawk-class carriers continued to make tremendous contributions to American foreign policy throughout the 1990s and early 2000s.

USS *Kitty Hawk* (CVA-63)

USS <i>Kitty Hawk</i> (CVA-63) / SCB-127A	
Funding authorized	Fiscal Year 1956
Keel laid	December 27, 1956
Launched	May 21, 1960
Commissioned / Decommissioned	April 29, 1961 / May 12, 2009
Nickname	Battle Cat

The namesake of the improved Forrestal-class carriers, *Kitty Hawk* was named in honor of the location of the Wright Brothers' first flight in 1903. *Kitty Hawk* held the distinction of being the first of its class launched and the last retired. Built in New York, the carrier was launched in May 1960 and joined the fleet in April 1961, with Capt William F. Bringle in command. *Kitty Hawk* did its shakedown cruise in the Atlantic and then performed an "around the horn" cruise to its new homeport in San Francisco.

The carrier made several WestPac deployments and returned to the yard for an eight-month overhaul, before heading to Vietnam in mid-1964 for the first of what would be seven Vietnam deployments. *Kitty Hawk* flew strikes as part of *Rolling Thunder* (1965–68) and *Linebacker I* (1972). The carrier entered dry dock in January 1973, and during this period received its first conversion modifications to become a multipurpose carrier (CV), which meant it would be able to operate antisubmarine aircraft as part of its air wing.

Kitty Hawk was the final conventional aircraft carrier to serve in the United States Navy. Retired in 2008, it spent its final years forward-deployed to Japan (US Navy).



These modifications included ten helicopter calibrating stations, sonar/sonobuoy readout and analysis center, and an Anti-Submarine Classification and Analysis Center (ASCAC) in the carrier's Combat Information Center (CIC). These changes were completed during the carrier's complex overhaul in 1976, which enabled it to operate the S-3 Viking. Other modifications to the catapults and JBD enabled operation of the new F-14.

In March 1984, while participating in a *Team Spirit* exercise off Japan, the carrier was damaged when a Soviet Victor-class nuclear submarine, K-314, surfaced directly beneath it.

The carrier continued to undertake Pacific deployments and was involved in Operation *Enduring Freedom* air strikes following the 9/11 attacks on New York and the Pentagon. *Kitty Hawk* served as the forward-deployed carrier from 1998 until September 2008, when it was replaced by USS *George Washington* (CVN-73). CVW-5, which has long been associated with the forward-deployed carrier, shifted to *George Washington*. *Kitty Hawk* ended a nearly 48-year career as the last conventionally powered carrier in the fleet. It was decommissioned on May 12, 2009, and is in inactive storage at Bremerton, to be held in reserve until 2015.



A carrier air wing of the mid-2000s features the E-2C Hawkeye airborne early warning aircraft (left), F/A-18C Hornet and F/A-18E/F Super Hornets, and EA-6B Prowlers. An H-60 Seahawk is visible on *Kitty Hawk*'s starboard side (US Navy).

USS Constellation (CVA-64)

USS Constellation (CVA-64) / SCB-127A	
Funding authorized	Fiscal Year 1957
Keel laid	September 14, 1957
Launched	October 8, 1960
Commissioned / Decommissioned	October 27, 1961 / August 6, 2003
Nickname	Connie

Ordered on July 1, 1956, *Constellation* was the last aircraft carrier constructed in the New York Naval Shipyard. A fire during construction delayed the construction by some seven months and cost an additional \$75 million. *Constellation* was launched in October 1960 and commissioned a year later, with Capt T. J. Walker as commanding officer. The carrier underwent its initial sea trials and training off the Virginia coast and then steamed around the Horn of South America to take up residence in the Pacific Fleet in the summer of 1962.

On its second deployment *Constellation* found itself in the Tonkin Gulf when hostilities broke out in August 1964. This marked the first of six Vietnam deployments, which saw the carrier and its air wing claim 11 North Vietnamese MiGs in aerial combat, including those by the Navy's only aces of the Vietnam War, Lt Randall Cunningham and Lt (junior grade) Willie Driscoll, in May 1972. During *Constellation*'s 1968 deployment, the carrier spent 128 days on the line and its air wing flew over 11,000 combat and support sorties, dropping nearly 20,000t of ordnance. During the carrier's 1970 deployment, an F-4 Phantom crew claimed the first MiG kill since the end of *Rolling Thunder* operations in late 1968, and demonstrated the value of the Navy's recently formed Fighter Weapons School (TOPGUN).



USS *Constellation* (CV-64)
steams in support of Operation
Enduring Freedom (US Navy).

Constellation underwent its second overhaul from February 1974 to April 1976, at which time it converted to the CV standards to operate Tomcats and Vikings. *Constellation* began SLEP in February 1990, lasting until March 1993, and went on to participate in several Operation *Southern Watch* deployments and Operation *Enduring Freedom*. In the latter operations the carrier's air wing flew 1,500 sorties and dropped over 1.7 million lb of ordnance against Taliban forces. The carrier also participated in the making of the movie *Pearl Harbor* during the Doolittle Raid launch scenes. At the conclusion of its 21st deployment in 2003, the carrier ended 41 years of service. On April 17, an S-3B Viking recorded the carrier's 395,710th and final arrested landing. *Constellation* was replaced by USS *Ronald Reagan* (CVN-76). It remains in storage in Bremerton awaiting dismantling or sinking.

USS *America* (CVA-66)

USS <i>America</i> (CVA-66) / SCB-127B	
Funding authorized	Fiscal Year 1961
Keel laid	January 9, 1961
Launched	February 1, 1964
Commissioned / Decommissioned	January 23, 1965 / August 9, 1996
Nickname	The Big "A"

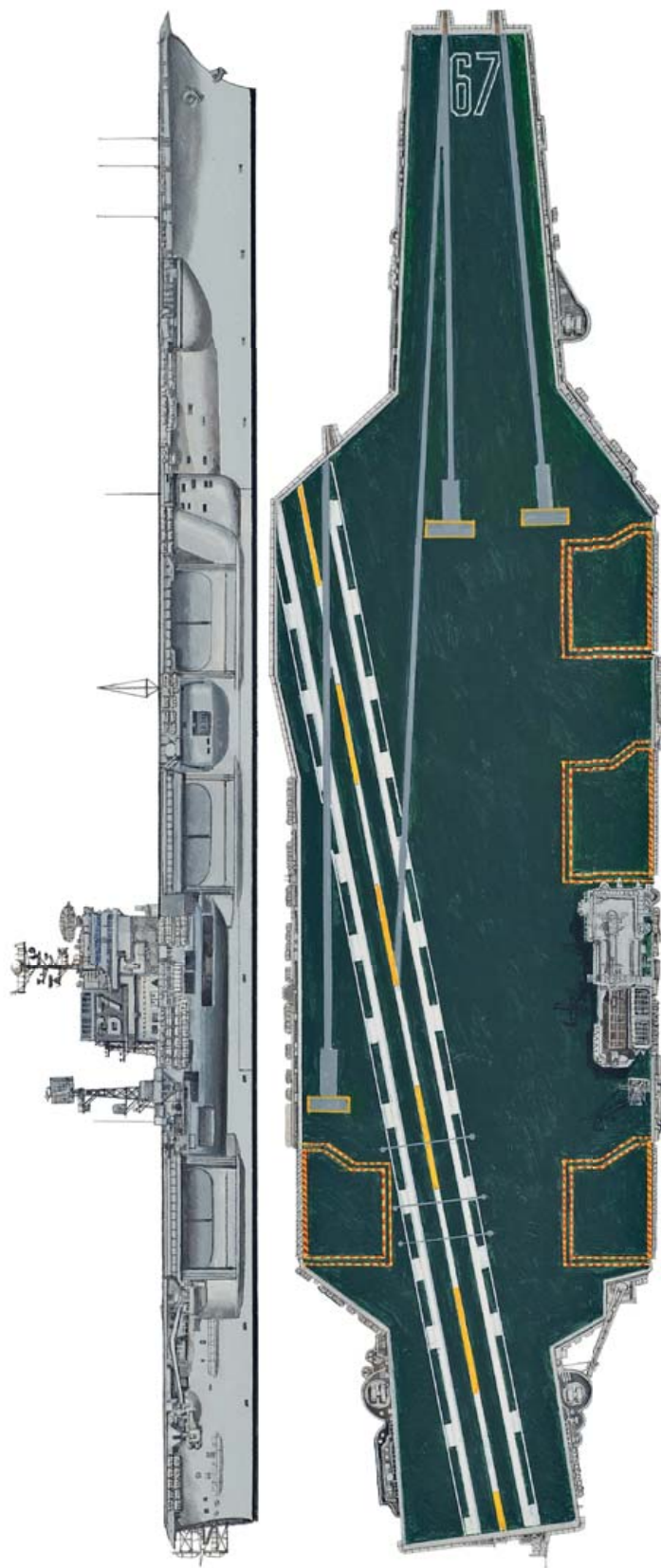
The last of the Kitty Hawk class, USS *America* was first ordered as a nuclear-powered carrier (part of the Enterprise class, CVAN-66) but was changed to a conventional carrier before construction began. Launched in February 1964, the carrier was commissioned in January 1965 under the command of Capt Lawrence Heyworth Jr. *America* was the subject of an aggressive naming campaign, which saw efforts to name it USS *Congress*, *Constitution*, *Alliance*, *Langley*, and *Williamsburg*.

America spent 1965 in shakedown cruise and work-ups in the Atlantic and was home-ported in Norfolk. The carrier made several Mediterranean cruises before deploying to Vietnam in March 1968. In four line periods over 112 days, the carrier flew strikes against North Vietnam and, in July, an F-4J from VF-33/CVW-6 downed a MiG-21. In November 1969, *America*

E

USS JOHN F. KENNEDY

Big John was originally intended to be a nuclear-powered aircraft carrier but was redesigned as a conventionally powered carrier after the high costs of USS *Enterprise* (CVAN-65). While the flight deck was arranged somewhat differently than prior Kitty Hawk-class carriers, the most noticeable feature of the *John F. Kennedy* was the canted smoke stack on the island.





TOP

USS *America* seen here steaming in the Atlantic in 1983. A Tomcat sits on catapult number one while a line of A-7E Corsair IIs are parked along the port bow catapult. The carrier's stem anchor is visible in this image. The stem anchor helped the chain avoid the carrier's underwater SQS-23 sonar (US Navy).

BOTTOM

USS *America* was the first carrier to have its Pri-Fly bridge moved from the aft island structure to the forward island. *America* also featured a smaller funnel. The large dome at the aft end of the island is the SPN-43A CCA radar for carrier approaches. The large webbed antenna on the aft island near the smoke stack is the SPS-43 3D long-range air search (US Navy).

participated in carrier suitability tests for the Lockheed U-2R before making its second Vietnam deployment in 1970. During that deployment, an A-7E from VA-146 made the type's combat debut. The carrier was on station for five line periods and during that time embarked CVW-9, flew 10,600 sorties (2,626 of which were combat sorties), made 10,804 carrier landings, and delivered 11,900t of ordnance. *America* made a third Vietnam deployment in 1972.

Following several more Mediterranean deployments during the 1970s, the carrier deployed off Libya in April 1986 in support of Operation *El Dorado Canyon*. Carrier aircraft from *America*, along with USS *Coral Sea*, struck SAM and AAA sites, suppressing enemy air defenses for other strike aircraft, including the US Air Force F-111s that had launched from bases in England. In 1990–91, *America* supported Operation *Desert Shield* and *Desert Storm*. *America* and its air wing, CVW-1, joined carriers *Saratoga* and *John F. Kennedy* in launching strikes from the Red Sea. Later in the conflict *America* moved into the Persian Gulf and became the fourth carrier in Battle Force *Zulu*, supporting strikes in Kuwait. *America* was the sole carrier to operate on both sides of the Arabian Peninsula during the war. CVW-1 flew 3,008 combat sorties and dropped over 2,000t of ordnance, destroying over 380 armored vehicles and tanks.

After the war the carrier made two Mediterranean deployments, with its 20th and final deployment including support of *Southern Watch* in the Persian Gulf and Operations *Deny Flight* and *Deliberate Force* in the Adriatic. Although scheduled to undergo SLEP in 1996 to extend its service until 2010, budgetary constraints forced the Navy to cancel the work and to retire the carrier after only 30 years of service. Following decommissioning in August 1996, the carrier was transferred to the Ready Reserve Fleet, and in May 2005 was sunk during explosive tests some 250 miles southeast of Cape Hatteras. *America*'s exact resting spot is 33°09'09"N, 71° 39'07"W. The carrier is reported to be sitting upright in one piece in 16,860ft (5,140m) of ocean.

USS *John F. Kennedy* (CVA-67)

USS *John F. Kennedy* (CVA-67) / SCB-127C

Funding authorized	Fiscal Year 1963
Keel laid	October 22, 1964
Launched	May 27, 1967
Commissioned / Decommissioned	September 7, 1968 / March 23, 2007
Nickname	Big John

Originally planned as a nuclear carrier, *John F. Kennedy* was ordered as a conventional carrier and was the last built as such. The carrier was named after President John F. Kennedy following his assassination in 1963 and was christened in 1967 by his then-nine-year-old daughter Caroline. The carrier was commissioned in September 1968.

Kennedy was home-ported in Norfolk and made several deployments to the Mediterranean. *Big John* was the last carrier to operate the piston-engined Skyraider; in this instance, the EA-1F version. The carrier was modified as a general-purpose carrier, CV, in the early 1970s, and continued to serve the Sixth Fleet throughout the 1980s. In 1989, two VF-32 F-14s from *Kennedy*'s air wing, CVW-3, shot down two Libyan MiG-23 Floggers that had threatened the battle group operating in the Mediterranean. *Kennedy* and CVW-3 supported Operation *Desert Storm* and served as the flagship of the Red Sea Battle Force. *Kennedy* was the last carrier to operate the A-7E Corsair II in combat. During the war, the carrier's air wing flew 2,895 sorties and 11,263 combat flight hours in 114 strikes, delivering over 3.5 million lb of ordnance.

Following the carrier's return from *Desert Storm* it underwent modifications to accommodate the F/A-18, which replaced the A-7E Corsair in the air wing. After this work, it made a single Mediterranean cruise wherein aviators logged the carrier's 250,000th arrested landing on December 8, 1992. The carrier returned from deployment and underwent a two-year comprehensive overhaul; in September 1995 it headed to Mayport to serve as the Navy's Reserve Operational Carrier. *Kennedy* made several deployments to the Mediterranean and in 2002 participated in *Enduring Freedom* operations over Afghanistan. In the course of 2,599 missions, the carrier's air wing delivered over 64,000lb of ordnance. Upon returning to the United States, the carrier conducted work-ups and carrier qualifications for several reserve and training squadrons, then entered a nine-month overhaul in early 2003. On its final deployment, *Kennedy* and CVW-17 supported *Iraqi Freedom*, flying 8,296 sorties for a total flight time of 21,824 hours. Of these, 4,396 sorties and 11,607 flight hours were in direct support of operations.

Due to rising operational and maintenance costs, in April 2005 the Navy canceled the carrier's scheduled 15-month overhaul and announced its retirement. After several "final" port stops, including Boston, the carrier was decommissioned in Mayport on March 23, 2007. *Kennedy* was initially stored at Norfolk and is now in Philadelphia as part of the reserve fleet. The namesake will continue as part of the Gerald Ford carrier class; CVN-79 has been named PCU *John F. Kennedy* and is expected to be commissioned in 2020–22.

USS *John F. Kennedy* (CV-67), considered a class of its own, shows an assortment of Tomcats and Hornets on its flight deck, as well as a small contingent of S-3 Vikings. The carrier retained its Van Velm bridle catchers on catapult number one and the waist catapult. Air operations have not yet begun, as is evidenced by the plane guard helicopter sitting on deck (US Navy).





An excellent view of *Kennedy's* outboard angled smoke stack is seen here. *Kennedy* was the only carrier of any class to feature such a design, although it has been seen on those of foreign countries, particularly Japan during World War II (US Navy).

THE ENTERPRISE CLASS

Discussions of nuclear-powered aircraft carriers date back to as early as 1946, during design of *United States*. In fact, while it was assumed that nuclear power would not be ready for the early designs, plans called for introducing nuclear propulsion later in the class construction. The Navy did not seriously undertake studies into nuclear power plants until the early 1950s, and then only in land-based prototypes. In November 1951, the Joint Chiefs of Staff established a formal requirement for a carrier reactor. At that time, the only studies underway focussed on nuclear power plants for the submarines, which were very different from the units needed for large surface vessels. Thus, the idea of simply upscaling the submarine design was not feasible. In 1954, a research and development program began with the goal of developing five reactor prototypes, including one for aircraft carriers.

By the mid-1950s, however, reactor technology had advanced sufficiently for construction of a nuclear-powered carrier. Thus, in FY58, following the authorization of six Forrestal conventional carriers, funds were allocated for construction of the first

nuclear-powered carrier, USS *Enterprise* (CVAN-65). However, the carrier was exceedingly expensive, costing nearly \$500 million (in 1961 dollars). Moreover, construction of *Enterprise* took longer than conventional carriers, which conflicted with the Navy's one-carrier-per-year plan toward a goal of 15 carriers. Given the expenses associated with nuclear power and the construction of *Enterprise*, the two additional carriers that had originally been planned as nuclear carriers – FY61/CVA(N)-66 and FY63/CVA(N)-67 – were redesigned as conventional carriers. Six Enterprise-class carriers were originally planned. Other names considered for the class included Constitution and Congress.

Propulsion

Enterprise was powered by eight Westinghouse AW2 reactors, each providing 35,000shp, for a total of 280,000shp. Each shaft turned a 64,500lb (32.5t), five-blade propeller, and four rudders were included, one aft of each propeller. The latter made *Enterprise* highly maneuverable. *Enterprise* was capable of at least 33kt (37.97mph) and, because of the amount of energy generated by the reactors, could steam indefinitely. When nuclear power was conceived, one of the assumed benefits was the ability to travel great distances without the need to refuel the carrier. This was indeed confirmed in 1964 by the now-famous world cruise (Operation *Sea Orbit*) of the nuclear task force of the carrier *Enterprise*, nuclear cruiser USS *Long Beach* (CGN 9),

F

USS AMERICA WITH A-6E INTRUDER AND A-7E CORSAIR II

An A-7E Corsair II (right) and an A-6E Intruder (left) ready for launch from catapults one and two aboard USS *America* (CVA-66) in 1982. The Corsair II served as the air wing's light bomber while the A-6E served as the medium bomber. The Corsair II was phased out in May 1991 and the Intruder retired in 1997; both aircraft, which served well during the Vietnam War, were replaced by the F/A-18 Hornet.





USS *Enterprise* (CVN(A) 65) was the world's first nuclear-powered carrier and, due to its high cost, is a class of one (US Navy).

and nuclear destroyer USS *Bainbridge* (DLGN 25). But a secondary benefit of nuclear power was the enormous amount of electricity and steam generated by the reactors, which could be used to power the latest electronics and steam catapults without degrading carrier performance.

The original uranium cores powered *Enterprise* for 200,000 miles and were replaced in 1965; another set of cores, albeit newly designed, were installed during 1969–71 after the carrier had steamed another 300,000 miles. These cores contained enough fuel to power

the carrier for the next decade. Additional refueling occurred during Complex Overhauls in 1981–82 and 1990–91, and at roughly ten-year intervals thereafter. The original cores cost over \$4,000,000, but the replacement cores cost less than \$3,500,000.

Stores

Enterprise carried considerably more aviation fuel, roughly 2,800,000 gallons, which allowed it to operate a larger air wing and for a long period of time. Even though the carrier was nuclear, which meant it did not need fuel for its engines, it nonetheless needed liquid as part of its hull protection system. *Enterprise* filled these spaces with additional jet fuel and also fuel for its escorts. To provide a reference point as to the size of the carrier, its distilling plants possessed a daily capacity of 280,000 gallons of water, roughly enough to supply the daily needs of over 1,400 homes.

USS *Enterprise* (CVN(A) 65) featured a unique island structure with a phased-array SPS-32 (horizontally wide) air surveillance and SPS-33 (vertical narrow rectangle) target tracking radar, which were part of the Hughes SCANFAR system. Lessons learned from this design were applied to develop the AEGIS Combat System currently used by Aegis cruisers and destroyers. The radar on the aft mast is an SPS-33. The S-2 Tracker on deck is preparing to make the first launch from the carrier (US Navy).



Flight Deck and Island

Enterprise's flight deck arrangement was similar to that of the *Kitty Hawk* class. *Enterprise* was a huge ship, measuring 1,123ft (342.2m) in length and displacing some 72,500t. This larger hull, needed to accommodate the reactors, also resulted in a larger flight deck measuring 1,079ft (328.8m) by 235.3ft (71.7m), and 720ft (219.4m) for the angled deck. The island structure, however, was much smaller than on earlier supercarriers because it was no longer necessary to have smoke stacks. In contrast to *Forrestal* and *Kitty Hawk*, *Enterprise* had a smaller, square-shaped island structure owing to its innovative flat-panel electronically

scanned radars, which were installed on the four faces of the island. The carrier featured the horizontal-shaped SPS-32 air surveillance search and vertical-shaped target-tracking SPS-33 (3-D) radar, which were referred to as the “billboard.” An SPS-12 (2-D) search radar was also added to the mast shortly after the carrier was launched because of reliability problems with the larger phased-array set and as a backup. The island was topped with a “turban-like” rotating ECM radar that gave the carrier a futuristic appearance. This configuration provided the carrier with 360-degree 3-D radar coverage with a greater scanning rate than conventional radars, and enabled detection at greater ranges.

The flag bridge was located just over the billboard radar with the navigation bridge above, stretching all around the island structure. A smaller Pri-Fly was located above the navigation bridge and extended over the edge of the island above the flight deck. A short mast sat on top of the turban, containing various communications antenna, navigation radar, and the TACAN. Provisions were also included for LORAN and a satellite navigation system. A series of 14 whip antennae were situated around the edge of the flight deck, which could be lowered horizontal and out of the way for air operations.

Defensive Armament

Although provisioned for missile batteries, the *Enterprise* was commissioned without any armament, instead relying on its air wing and escorts. In 1967, however, two Mk 25 eight-tube Sea Sparrow launchers were installed on sponsons along with their APQ-72 fire control radars. In 1968, the SPS-12 air search radar was added to this configuration. During *Enterprise*’s refueling and refit from 1991 until 1994, three Mk 15 Phalanx mounts were installed. The bridge was also reconstructed and SPS-48C, SPS-49, and SPS-65 Sea Sparrow search radars replaced the earlier radars. A Mk 23 target acquisition radar and the SPN-41 landing aid and two SPN-46 air traffic control radars were also added. In the 2000s two RIM-116 Rolling Airframe Missile (RAM) systems were added, each using the Mk 49 Guided Missile Launching System (GMLS), which consists of the Mk 144 Guided Missile Launcher (GML) unit and 21 stores for mount.

USS *Enterprise* (CVAN-65)

USS <i>Enterprise</i> (CVAN-65) / SCB-160	
Funding authorized	Fiscal Year 1958
Keel laid	February 4, 1958
Launched	September 24, 1960
Commissioned / Decommissioned	November 25, 1961 / December 1, 2012 (out-of-service date)
Nickname	Big E



Seen here in 1990, *Enterprise* shows the modified island structure following replacement in 1980 of the SPS 32 and SPS-33 radars with conventional air search radars. SCANFAR was replaced with the SPS-48E (US Navy).



USS *Enterprise* conducts air operations during 2003. An S-3B Viking can be seen on the aft deck. Vikings were performing all of the air wing aerial refueling at that time (US Navy).

The world's first nuclear powered carrier, *Enterprise* continued the tradition of the venerable World War II-era USS *Enterprise*, CV-6, and was the eighth US naval vessel to bear the name. The carrier was commissioned on November 25, 1961, with Capt Vincent P. De Poix as its commanding officer. The carrier began with a lengthy shakedown cruise in early 1962, which included serving as a tracking and measuring station for the flight of *Friendship 7*, America's first orbital spacecraft. The carrier performed so well during its six-day builder's trials that the Navy immediately accepted it.

Enterprise joined the Atlantic Fleet, being based in Norfolk, and served there until 1965. In that time it participated in the blockade of Cuba during the 1962 missile crisis as part of Task Force 135 along with four other US carriers, including *Independence*. Immediately following the missile crisis, *Enterprise* participated in catapult launch tests with an E-2A Hawkeye and A-6A Intruder to evaluate the new nosewheel launch bar system, which eventually replaced the bridle system.

Enterprise made two subsequent deployments to the Mediterranean, and in the latter cruise participated in Operation *Sea Orbit*, the world's first nuclear-powered world cruise. By October 1964 *Enterprise* was ready for its first refueling and overhaul. In November 1965 the carrier transferred to the Pacific Fleet, where it made two deployments to Vietnam from 1965 through 1967. Its December 2 deployment marked the first use of a nuclear-powered carrier in combat. Indeed, on December 3, the carrier set a record of 165 strike sorties in a single day.

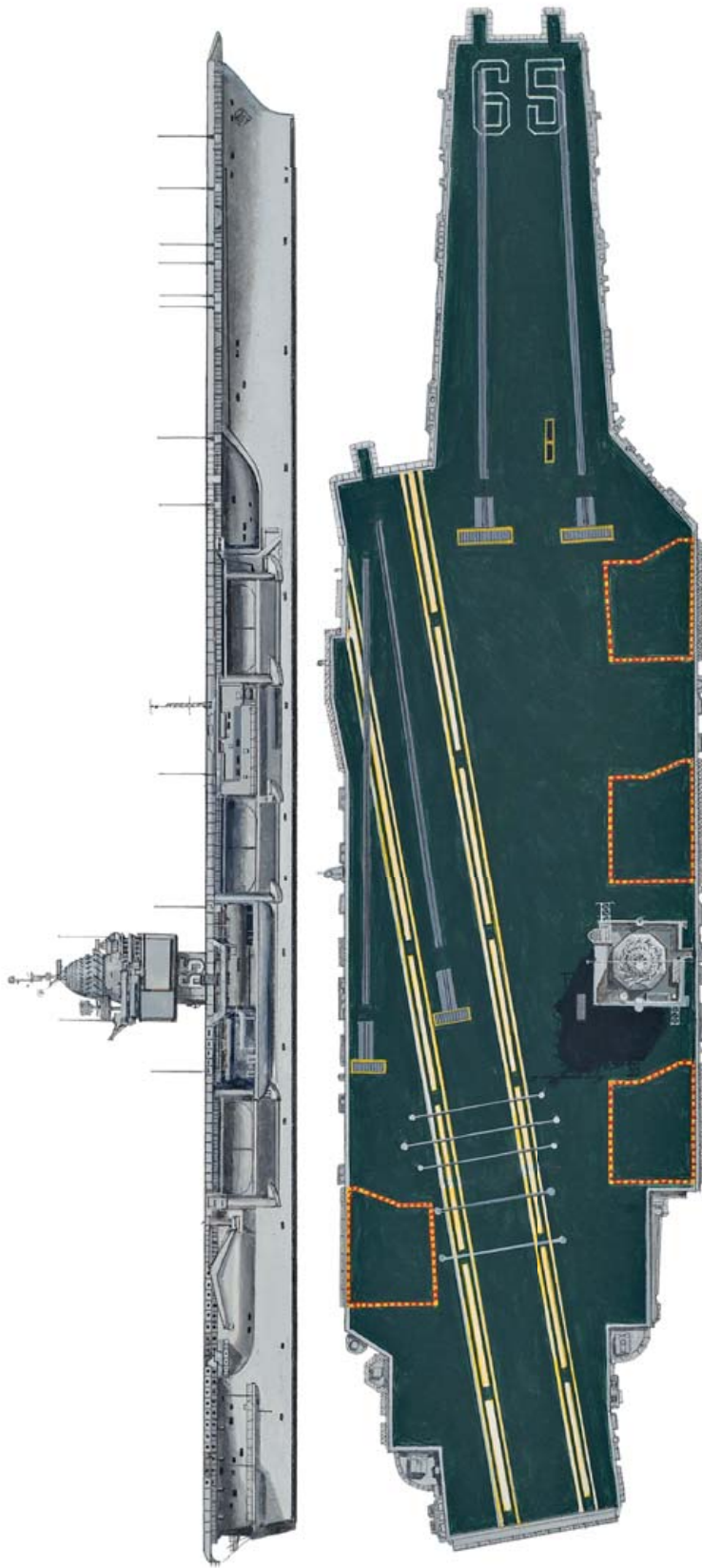
In January 1969, the carrier suffered a devastating fire when, similar to *Forrestal*, a Zuni rocket pod "cooked off" due to overheating, starting fires on the deck. In the end, the fire destroyed 15 aircraft and killed 25 crew members, injuring another 314. Repairs were undertaken at Pearl Harbor, lasting into March, and the carrier resumed its deployment to Vietnam. By war's end, *Enterprise* had made six Vietnam deployments, including operations in support of *Linebacker I* and *Linebacker II*.

In early 1973 *Enterprise* underwent modifications to allow operation of the new F-14 Tomcat, which saw two of the four JBDs enlarged. In March

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USS ENTERPRISE

The world's first nuclear-powered aircraft carrier, *Enterprise* introduced many unique features, including a larger flight deck and a box-shaped flat panel phased array radar. The island structure was modified in the late 1970s and early 1980s to incorporate more conventional radars. *Enterprise* had eight nuclear reactors, compared with the two reactors found in the current Nimitz-class and Gerald Ford-class carriers of today.



1974, VF-1 and VF-2, the first two operational Tomcat squadrons, completed their initial carrier qualifications before making the type's maiden deployment in September. Over the course of the 1970s and 80s, *Enterprise* made numerous WestPac deployments and on its 13th deployment, in 1988, helped escort reflagged Kuwaiti oil tankers in the Persian Gulf as part of Operation *Earnest Will*.

Enterprise remained in the Pacific until 1990, and after it completed a complex refueling (the largest ever performed to date) in 1994, was re-assigned to the Atlantic Fleet. During the 1990s *Enterprise* supported air operations in *Southern Watch*, *Desert Fox* (1999), and Bosnia (1995). *Enterprise* supported strikes against Afghanistan in 2001 during *Enduring Freedom*, launching nearly 700 missions and dropping over 800,000lb of ordnance over three weeks. Following a Selected Restricted Availability, the carrier was again in combat in early 2003 supporting *Iraqi Freedom*.

Enterprise made its final deployment in 2012, returning to the United States in late November and was officially deactivated on December 1. In June 2013 the carrier was towed to Huntington Ingalls Industries Newport News Shipyard to begin a lengthy decommissioning process to remove its nuclear fuel. The carrier will be stricken from the US Naval Vessel Register in 2017. The carrier made 25 deployments and served 51 years, the longest duty by any aircraft carrier. Its namesake will continue, as CVN-80 has officially been given the title PCU *Enterprise*, making it the ninth ship to bear the name.

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The four aircraft carriers of Battle Force Zulu are seen here returning from *Desert Storm* in March 1991. *Zulu* was stationed in the Persian Gulf. Pictured are USS *Midway* (top left), USS *Ranger* (lower left), USS *Theodore Roosevelt* (upper right), and USS *America* (lower right), which represent several of the major US Navy carrier classes built since World War II (US Navy).



INDEX

References to illustrations are shown in **bold**.

Afghanistan 5, 30, 35, 36, 39, 46
America, USS 17, 19, 24, 26–31, 27, 30, 31, D (32, 33), 36–38, 38, F (40, 41), 47
Antietam, USS 14
 Berlin Crisis (1962) 25
 Bosnia 5, 38, 46
 Bringle, Capt William F. 34
 Bureau of Ships (BuShips) 12, 26
Carl Vinson, USS 17
 Carrier Air Wing (CVW) 16
 Carrier On-Board Delivery (COD) aircraft 14
Constellation, USS 16, 19, 26–30, 27, 35–36, 36
Coral Sea, USS 7, 19, 38
 Cuban Missile Crisis (1962) 23, 25, 44
 De Poix, Capt Vincent P. 44
 deck design *see* flight deck design
 defensive systems
 Enterprise class 43
 Forrestal class 18–19
 John F Kennedy class 32
 Kitty Hawk class 27–30
 deployments
 Enterprise class 43–46
 Forrestal class 20–26
 John F Kennedy class 38–39
 Kitty Hawk class 34–38
 design and modifications
 Enterprise class 40
 Forrestal class 11–14
 John F Kennedy class 31–34
 Kitty Hawk class 26–27
 electronic systems and radar
 Enterprise class 42–43
 Forrestal class 19, 20
 Kitty Hawk class 30–31
 Ely, Eugene 5
 Enterprise class 4–5
 defensive systems 43
 deployments 43–46
 design and modifications 40
 electronic systems and radar 42–43
 Enterprise 5, 24, 42, 43, G (44, 45)
 flight deck design 27, 42–43
 propulsion 40–42
 stores 42
 Essex-class 7, 8, 10, 11, 12, 16
 Flatley III, Lt James H. 22, 23
 flight deck design
 Enterprise class 27, 42–43
 Forrestal class 13–14, 15, 15–16
 John F Kennedy class 32
 Kitty Hawk class 17, 26–27
 Forrestal class 4–5
 Carrier Air Wing (CVW) 16
 crew 15
 defensive systems 18–19
 deployments 20–26

design and modifications 11–14
 electronic systems and radar 19, 20
 flight deck design 13–14, 15, 15–16
Forrestal 5, 5, 12–23, 14, 15, 19, 20, 22, C (28, 28)
Independence 13, 14, 16, 19, 25
 launch and recovery operations 16–18
 propulsion 19–20
Ranger A (8, 9), 14, 16, 18, 19, 19, 24, 24–25, 25, 47
Saratoga 14, 16, 17, 19, 20, B (20, 23), 23, 23–24
 Service Life Extension Program (SLEP) 19
 stores 18
 structures 14–15
 Fresnel Lens Visual Landing Aid system 17
George H. W. Bush, USS 26
George Washington, USS 35
 Heyworth Jr., Capt Lawrence 36
Independence, USS 13, 14, 16, 19, 25
 Iraq 5, A (8, 9), 22, 24, 25, 38, 39, 46, 47
 John F Kennedy class
 defensive systems 32
 deployment 38–39
 design and modifications 31–34
 flight deck design 32
 John F Kennedy 4, 17, 19, 27, 30, 31, 31, E (36, 37), 39, 40
 Johnson, Capt R. L. 20
 Johnson, Louis 10, 12
Jupiter, USS 6
 Kitty Hawk class 4–5, 5 *see also* John F Kennedy class
 America 17, 19, 24, 26–31, 27, 30, 31, D (32, 33), 36–38, 38, F (40, 41), 47
 Constellation 16, 19, 26–30, 27, 35–36, 36
 defensive systems 27–30
 deployments 34–38
 design and modifications 26–27
 dimensions and displacement 30
 flight deck design 17, 26–27
 Kitty Hawk 5, 19, 24, 26, 26–31, 30, 34–35, 35
 propulsion 30
 Service Life Extension Program (SLEP) 19
 structures 31
 Korean War (1950–53) 11, 12
 Kosovo 5
 Langley, Samuel 5
Langley, USS 6, 6, 13
 launch and recovery operations, Forrestal class 16–18
 Lebanon 25
Lexington, USS 6, 23
 Libya 23, 38, 39

Magic Mirror system 17
 Matthews, Francis P. 12
 McElroy, Capt R. Y. 25
Midway, USS 7, 14, 47
 Midway class 7, 8, 10, 11
 Naval Appropriations Act (1949) 10
 Navy Ship Characteristic Board (SCB) 8
 Nimitz, Admiral Chester 7
 Nimitz class 27
Northern Wedding, Exercise (1978) 22
 Operation *El Dorado Canyon* (1986) 38
 Operation *Restore Hope* (1992) 24
 Operation *Sea Orbit* (1964) 44
 Operation *Strikeback* (1957) 23
 Operation *Urgent Fury* (1983) 25
Oriskany, USS 8
 Pearl Harbor, attack on (1941) 7
Perseus, HMS 13
 Primary Flight Control (Pri-Fly) 15, 15, 31, 38
 Project 27A 8
 propulsion
 Enterprise class 40–42
 Forrestal class 19–20
 Kitty Hawk class 30
 radar *see* electronic systems and radar
Ranger, USS 6, A (8, 9), 14, 16, 18, 19, 19, 24, 24–25, 25, 47
Ronald Reagan, USS 36
Saratoga, USS 6, 14, 16, 17, 19, 20, B (20, 23), 23, 23–24
 Service Life Extension Program (SLEP) 19
 stores
 Enterprise class 42
 Forrestal class 18
 Stroh, Capt Robert Joseph 23
 structures
 Forrestal class 14–15
 Kitty Hawk class 30, 31
Theodore Roosevelt, USS 47
Triumph, HMS 13–14
 Truman, President Harry S. 10
United States, USS 8, 8–11, 12, 13, 14
 Vietnam A (8, 9), 22, 23, 24, 25, 34, 35, 36, 38, 44
 Vinson, Carl 11–12
 Walker, Capt T. J. 35
 Washington Naval Treaty (1922) 6
 weapons *see* defensive systems
 World War I (1914–18) 5
 World War II (1939–45) 7
 Yorktown class 6

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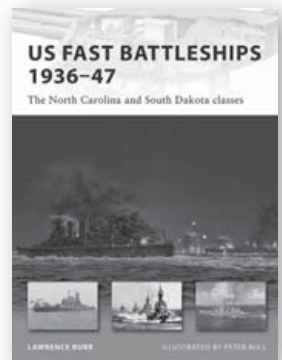
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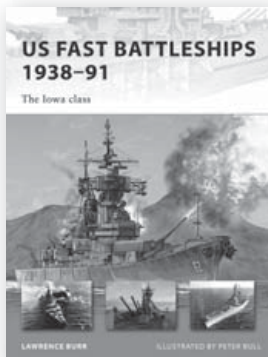
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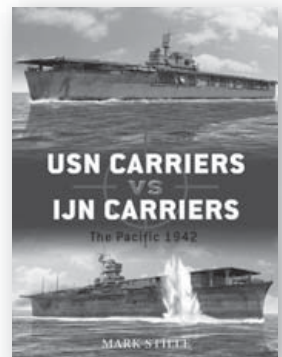
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EDITOR'S NOTE

All ship displacements in this book are in long tons. All other tonnages (fuel, ordnance etc) are short tons. For ease of comparison please refer to the following conversion table:

1 mile = 1.6km
1yd = 0.9m
1ft = 0.3m
1in = 2.54cm/25.4mm
1 gallon (Imperial) = 4.5 litres
1lb = 0.45kg